State of Rhode Island and Providence Plantations.

REPORT OF THE COMMISSIONER

FOR THE

SUPPRESSION

OF THE

GYPSY AND BROWN-TAIL MOTHS.

Plate I. GIPSY MOTH

Fig. 1, 2, female moths; Fig. 3, 4, male moths; Fig, 5, pupa; Fig. 6, female caterpillar; Fig. 7, male caterpillar; Fig. 8, egg-cluster; Fig. 9, eggs magnified; Fig. 10, egg highly magnified.

After the Mass. Board of Agriculture.

AT ITS

JANUARY SESSION, 1907.

PROVIDENCE:
E. L. FREEMAN COMPANY, STATE PRINTERS.
1907.

To the Honorable General Assembly of the State of Rhode Island and Providence Plantations at its January Session, 1907*:*

In compliance with the directions of a resolution passed by the General Assembly at its January session, 1906, and making appropriations for the suppression and extermination of the gypsy and brown-tail moths, I have the honor to submit herewith the report of my work as Commissioner, appointed under the provisions of this resolution.

A. E. Stene.

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STATE OF RHODE ISLAND.

IN GENERAL ASSEMBLY,

January Session, A. D. 1906.

RESOLUTION

MAKING AN APPROPRIATION FOR THE SUPPRESSION AND EXTERMINATION OF THE GYPSY AND BROWN-TAIL MOTHS.

Resolved, That the sum of fifty-one hundred dollars or so much thereof as may be necessary be and the same is hereby appropriated, out of any money in the treasury not otherwise appropriated, to be used for the purpose of suppressing and exterminating the gypsy and brown-tail moths in this state; and

Resolved, That the governor be and he is hereby authorized to appoint some experienced citizen of this state a commissioner, who shall serve without pay excepting for actual and necessary expenses while carrying out the provisions of this resolution, whose duty it shall be to see that the said fifty-one hundred dollars is properly and judiciously used in the suppression and extermination of the gypsy and brown-tail moths; and the state auditor is hereby authorized to draw his orders on the general treasurer for the above sum of fifty-one hundred dollars, or so much thereof as may be needed, upon the presentation of properly authenticated vouchers. Said commissioner and persons in his employ may at all proper times enter upon any land of the state or of a municipality, corporation, or other owner or owners, and may use all reasonable means in carrying out the provisions of this resolution:

Provided, however, that no part of this money shall be paid without the approval of the governor who on examination shall be satisfied that the appropriation has been properly used before signing the vouchers; and said commissioner is hereby directed to make a full report of his doings to the next January session of the general assembly.

STATE OF RHODE ISLAND.

OFFICE OF THE SECRETARY OF STATE,

PROVIDENCE, April 30, 1906.

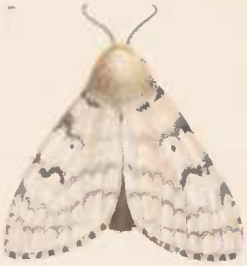
I certify the foregoing to be a true copy of the resolution passed by the General Assembly of said State on the 20th day of April, A. D. 1906.

In testimony whereof I have hereunto set my hand and affixed the seal of the State aforesaid the date and year first written above.

CHARLES P. BENNETT,

Secretary of State.

1.



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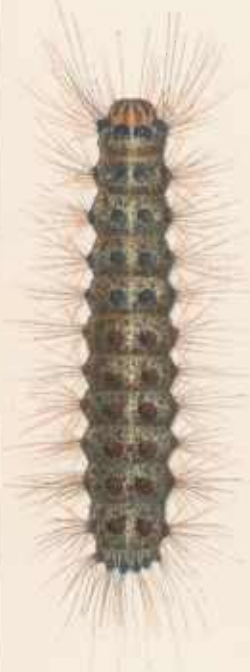

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Drawn by Joseph Bridgham.

Geo. H. Walker & Co., Boston.

GYPSY MOTH.

PREFACE.

It is intended in this report to give a short historic account of the gypsy and brown-tail moths and their occurrence in this country, together with a description and life history of both insects. A detailed account of methods of work employed and the various expenditures will also be given. It is thought best that this report should go quite fully into details, so that the citizens of the State may have a fairly complete understanding of the problem at hand and the various methods used in dealing with the pests. This seems quite essential in order that the many of our private citizens who realize the great menace of the presence of these pests, and who individually wish to do all in their power to help in exterminating or suppressing them, may have an intelligent understanding of their nature and of the methods of procedure against them.

According to the resolution the Commissioner is responsible to the Governor of the State for the proper execution of his work, and it is with sincere respect that the writer acknowledges the generous encouragement which His Excellency, Governor Utter, has at all times given to the work, and the plain, straightforward manner in which he has given his counsel regarding such questions as came to him for attention and decision.

The writer is under great obligations to the Board of Managers of the Rhode Island College and to Presidents Butterfield and Edwards for every encouragement in the prosecution of this work. To Dr. Wheeler, director of the Rhode Island Experiment Station, is due sincere acknowledgment for suggestions as to plans for the campaign. To him also is no doubt due the credit of having put forth the greatest efforts toward creating a public sentiment favorable to an appropriation in this State, and of having done much effective

work in helping to secure the national appropriations in Congress.

Many other citizens have manifested constant and lively interest in the work and have aided in every way possible. Notable among these are Messrs. E. A. Noyes, President of the League of Improvement Societies in Rhode Island; Alfred Stone of the Board of Metropolitan Park Commissioners; Prof. John Barlow of the R. I. College of Agriculture and Mechanic Arts; and C. A. Davis, Curator of the Roger Williams Park Museum.

To the newspapers of the State is due the credit of having been ready to publish at any time plain statements of facts regarding the work, and items of interest intended to explain the methods of work and how best the citizens could help.

The success of work like that discussed in this report depends ultimately, to a very great extent, upon the thoroughness and conscientiousness with which the orders are carried out by the men in the field, and it is a pleasure to acknowledge the excellent and faithful service of the field agent, Mr. John Sweeney, and the inspectors and men who have labored under him.

And finally, to the great body of citizens of the State is due acknowledgment for kindly and active interest in the campaign against the pests. There seems to be a general appreciation throughout the whole State that the gypsy moth is an injurious insect of more than common importance and that it behooves everyone to do his share in helping to eradicate the pest. There has also been an entire absence of that undesirable attitude, so loudly complained of in public life to-day, which fails to support or seeks to hinder the administration of public appropriations according to the plain duties in the case and the honest convictions of those in charge, unless there is some "extra money" or unnecessary patronage in it for somebody.

Outside the State, the writer is under great obligations to Supt. A. H. Kirkland of the Massachusetts gypsy moth work, and to Mr. D. M. Rogers now in charge of the Federal work in New England, for the unfailing courtesy and ready willingness to help in our work in this State. Much correspondence and many conferences have been

PLATE II.

Menotomy Rocks Park, Arlington, Mass., June, 1905. Defoliated by the gypsy moth caterpillar. After Kirkland.

had with both of these gentlemen to discuss plans for the work, and they have given freely of their time and of their fund of experience gained in more than a decade of stubborn fighting of the gypsy and brown-tail moths in Massachusetts.

There are many others who could readily be mentioned as having contributed in various ways toward the success of this work, but as the preface is already quite lengthy, further acknowledgments will be given whenever possible in the body of the report.

The writer now begs to present a more or less personal statement in order that his relation, as well as the relation of the Rhode Island College, a member of whose faculty he has the honor to be, to the work may be a little more clearly understood. It is the modern conception of agricultural colleges, and especially those that have established extension departments, that they should seek to promote the agricultural interests and welfare of their respective states in so far as it lies within their power. Not the least of this work in Rhode Island has consisted in the dissemination of knowledge regarding plant pests of various kinds. The Rhode Island College of Agriculture has been fully aware of the presence of the gypsy moth, and it was President Butterfield's instruction, at the very beginning of the writer's work in the extension department, to do everything possible toward fighting the pest. Unfortunately no funds were available for any active work and all that could be done was to visit the infested region, watch the spread of the insect, and seek to enlighten the public in regard to its dangerous character. Numerous visits were made to the infested region, at the request of residents, for the purpose of determining whether the pest was present on their grounds, and information was given orally and by letter of the best way of dealing with it if found.

It was a surprise to the writer when the appointment as Commissioner came, but as it was clearly in the line of duties of an agricultural college, not only according to the principle of service already mentioned, but also from the precedent established in many other states when similar work has been undertaken, the task was ac-

cepted. It has had its drawbacks and its recompense. It has imposed a great deal of additional care and labor for which no remuneration could be expected; and yet as it has been in line with the writer's only hobby, if it may be so called, of plant-pest study, the work has grown in interest as its various problems have presented themselves.

Only a beginning has been made, and whether the State will deem the recommendation to continue the fight worthy of approval, and whether, if an appropriation is made, his past record will justify that he be delegated to continue the work, the writer will always have a deep interest in the grave agricultural and economic problem which the importation of this insect has forced upon New England, and, unless it is checked in its present range, upon the whole country.

PLATE III.

A treeless street. This is by no means a type of Providence streets at the present time. The unrestricted spread of the gypsy moth may compel its adoption, however, or else the expenditure of a great deal of money in the preservation of our present tree-lined roads and avenues in the cities and towns.

*HISTORY OF THE INTRODUCTION OF THE GYPSY MOTH INTO THE UNITED STATES.

The history of the introduction of the moth is quite well known to those who have been interested in the fight that Massachusetts has been making against the pest. To many of the people of Rhode Island, however, who have not until recently realized that this State may have to face a similar problem before so very long, the history is probably not so well known. It is, therefore, desirable that a short account should be given, in this report, of the time and manner in which this pest was introduced.

The exact time of the introduction of the gypsy moth has not been determined, but it is known that Mr. Leopold Trouvelot, a Frenchman who was employed as an instructor in astronomy at Harvard, and who was also somewhat of a naturalist, imported, sometime during 1868 or 1869, a number of egg clusters of this insect. His object in so doing was to attempt the breeding of a hardy silkworm. It is well known that the common silkworm is subject to a great many diseases and that, therefore, it is rather difficult to rear. The so-called "American silkworm" is also subject to a great many parasitic enemies. What Mr. Trouvelot's plans were for attaining his purpose is not exactly known, but it is supposed that he intended to make an attempt, by crossing, to produce a new and hardy insect, either from the common silkworm or from the American form, and that for this purpose he imported the gypsy moth. There is no doubt that he selected the gypsy moth for this purpose because of its well-known hardiness in its native habitat.

* Historical data for this account has been obtained largely from the reports of the Mass. work against the gypsy moth.

It is not necessary to dwell upon the fact that so far as hardiness is concerned the insect was well chosen for the object he had in view. New England people of to-day fully realize that the gypsy moth is extremely hardy and subject to but few parasitic enemies, and that were it really useful as a silk-producing insect or otherwise, it might be a great source of income to the section of the country in which it is found.

At the time that Trouvelot was doing this work he lived at No. 27 Myrtle street, Glenwood, Medford. It is known that he was fully aware of the destructive nature of the insect which he had imported, and that he sought to keep it confined. By some accident the insect escaped; just how is not absolutely known, as he had returned to France before the people actually began to realize the dangerous character of the insect. He announced the escape in a number of entomological papers and called attention to the fact that efforts should be made to destroy the insect at once. A few of the entomologists of the country, notably C. V. Riley, then State Entomologist of Missouri, recorded the appearance of the insect in this country in 1870 and stated that it was a very destructive pest in its native habitat. People generally, however, paid no attention to the presence of the insect, and it seems to have been forgotten almost entirely until about 1889, when the caterpillars became so numerous that specimens of the insect were sent to Dr. Fernald, Entomologist of the Massachusetts Agricultural College, for identification. Dr. Fernald was absent at the time, but his wife, who is also an entomologist, traced the insect in the entomological literature and found it to be the gypsy moth so well known in Europe.

During the twenty years which had elapsed since its introduction the insect had been slowly increasing and spreading from the district in Medford where it was first introduced. It had been found in certain localities in destructive numbers, but people generally had fought it without any definite idea of what kind of an insect it was, speaking of its larvæ as the "caterpillars" or "worms." It was taken by some to be the Army worm, outbreaks of which occur from time

to time throughout the country. In order that it may be realized what a scourge it had become by the time the people began to make concerted efforts to secure State aid for its destruction, the following abstracts, taken from the Special Report on the Gypsy Moth, issued by the Massachusetts State Board of Agriculture in 1897, may be of interest:

"The number of caterpillars that swarmed over certain sections of the town during the latter part of June and most of July, 1889, is almost beyond belief. Prominent citizens have testified that the "worms" were so numerous that one could slide on the crushed bodies on the sidewalks; and that they crowded each other off the trees and gathered in masses on the ground, fences, and houses, entering windows, destroying flowering plants in the houses, and even appearing in the chambers at night. The huge, hairy, full-grown caterpillars were constantly dropping upon people on the sidewalks beneath the trees, while the smaller larvæ, hanging by invisible threads, were swept into the eyes and upon the faces and necks of the passers. The myriads that were crushed under foot on the sidewalks of the village gave the streets a filthy and unclean appearance. Ladies passing along certain streets could hardly avoid having their clothing soiled, and were obliged to shake the caterpillars from their skirts. Clothes hanging upon the line were stained by the larvæ which dropped or blew upon them from trees and buildings. In the warm, still summer nights a sickening odor arose from the masses of caterpillars and pupæ in the woods and orchards, and a constant shower of excrement fell from the trees. The presence of this horde of gypsy-moth larvæ had become a serious nuisance and was fast assuming the aspect of a plague. The condition of affairs at this time is best shown by the extracts from statements of residents."

"'When the caterpillars were small they would spin down on their threads and blow out into the street and even entirely across it. The caterpillars were a dirty pest. You could hardly go out of doors or sit down anywhere without getting them over you. Trees were either completely stripped so that not a green thing was to be seen on them, or else were eaten so that the skeletons of the leaves only remained. The caterpillars were very numerous on a large tree behind my house. I have scraped them off by the quart on the fence and shed adjoining the tree. They clustered as thickly as bees swarm. Before caterpillar time we used to see bodies of trees plastered all over with their egg clusters. They were so thick on certain trees that they reminded me of shells at the sea-shore.' (J. H. Rogers, 17 Spring street.)

'We spent hours killing caterpillars on them (street elms.) We would get two

quarts at a time. They were very large. They got into every crevice and under every piece of bark. Our neighbor across the way, Mrs. Turner, used to go out with a pail of hot water and poke the caterpillars into it with a stick. My son used to tie a rag soaked with kerosene around a pole and set it on fire and singe them off the trunks of the trees.' (F. E. Foster.)

'I had charge of this estate (Sparrell estate, Main street), and I killed a great many caterpillars by brushing them off the trees with a broom and crushing them. After brushing them off the trees, I would wait half an hour and then there would be just at many again on the trees. I could have gathered a half-bushel of caterpillars every evening through their season' (Richard Pierce.)"

These conditions aroused the people to such an extent that public action had to be taken for the purpose of fighting the pest. A movement was set on foot with the view of obtaining legislative action and appropriations for the purpose of aiding in the fight. An act was passed and approved March 14, 1890, creating a commission with power to conduct the fight and appropriating a sum of $25,000 with which to prosecute the work. The commission was soon dissolved, however, and the work was placed in the hands of the State Board of Agriculture, which carried it on for nine or ten years with notable success, and expended approximately three-fourths of a million dollars. At the end of this period the moth had been exterminated in a great many of the sections where it had been found, and so reduced everywhere that when a committee was appointed by the State Legislature to investigate the need of further appropriations, the men who were interested in continuing the work until a complete extermination should be arrived at were unable to show insects, or the results of their work, in sufficient quantity to convince the committee that an appropriation was necessary. The report of this committee as quoted by Superintendent Kirkland in his first annual report of 1906 is interesting because it indicates the thoroughness with which the first campaign had been carried out, and incidentally it is the greatest compliment that could have been paid to those who had prosecuted the work. It is as follows:

"We find no substantial evidence that gardens, crops, or woodlands have suffered serious or lasting injury, or are likely, with that proper precaution or oversight which property owners are supposed to give to their own interest, to be subject to the devastation which one would have in mind to anticipate from these reports. . . . It appears to us that the fears of the farmers throughout the State have been unnecessarily and unwarrantably aroused, evidently for the purpose of securing the effect of those fears upon the matter of the annual appropriations. . . We do not share these exaggerated fears, and the prophecies of devastation and ruin are unwarranted and in the most charitable view are but the fancies of honest enthusiasts."

That this committee was not as fully aware of the dangerous character of the pest as those who had been working with it became apparent through subsequent history of it in Massachusetts. According to Superintendent Kirkland but little damage was noted during the years 1900 and 1901. It was rapidly increasing, however, and in 1902 a number of estates were invaded and the trees stripped.

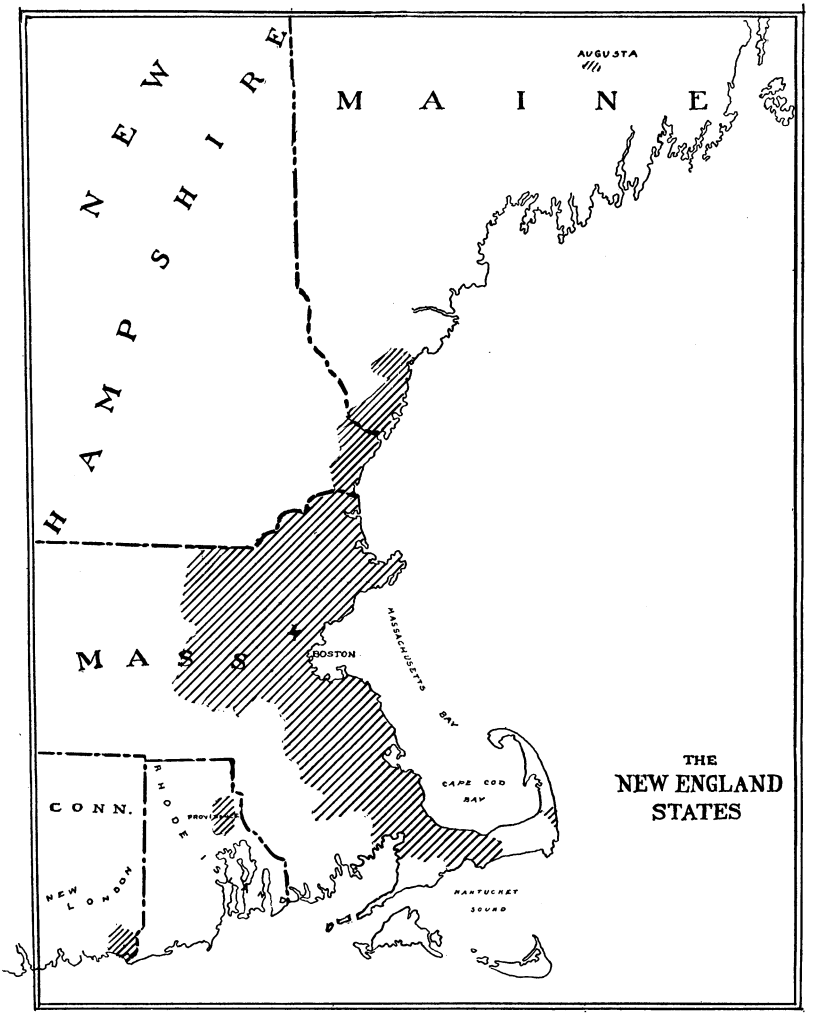
This was especially so on the property of non-resident owners where no attempt was made at keeping it in check. In 1904 it became evident to even the casual observer that the moth had reinfested the area which it had formerly occupied and was rapidly spreading.

The people again became awake to the necessity of concerted action. The combined activities of the gypsy and brown-tail moths so thoroughly stripped many sections in the neighborhood of Boston that the territory looked as if swept by fire. Again quoting from Kirkland's report:

"The hungry caterpillars of both species of moths swarmed everywhere: they dropped on persons, carriages, cars and automobiles, and were thus widely scattered. They invaded houses, swarmed into living and sleeping rooms and even made homes uninhabitable. Thousand of cases of poisoning of human beings resulted from the swarming of the brown-tail caterpillars. Real estate in the worst infested districts underwent a notable depreciation in value. Worst of all, pines and other conifers—altogether too scarce in Eastern Massachusetts—were killed outright by the gypsy-moth caterpillars, while shade trees and orchards were swept bare of foliage. Property owners who were disposed to care for their own estates suffered and became discouraged from the neglect of their neighbors.

It was evident that the moth pests were in the ascendency, and that they could be controlled only by prompt, thorough, and systematic effort."

The people were thoroughly aroused. Individuals, and agricultural and horticultural societies, civic improvement leagues, and forestry associations, were a unit in demanding legislative action for the suppression of the pests. The resulting bill was signed by Governor Douglas, May 8, 1905. This bill provided for the appointment of a commissioner by the Governor, and the direct appropriation of $250,000. The act was an improvement in a great many ways on that which had formerly been in force, but principally in that it placed the work in the hands of one man as superintendent and made him alone responsible for the work. Governor Douglas appointed Mr. A. H. Kirkland, who had been connected with the work during nearly all of the period of the first campaign. Superintendent Kirkland at once entered on his duties, and one of his first objects was to find out to what extent the moth had spread during the period of inactivity in the fight against it. The results were truly astonishing. It was estimated that at the close of the first work in 1900 there were thirty-four cities and towns infested and an area of 359 square miles. At the close of 1905, while as yet the scout work had not been completed, the infested section embraced 124 cities and towns and an area of 2,224 square miles. Since then further inspection has revealed the presence of the moth in a few places outside of this district. It became evident, therefore, that even with the best work possible all that could be done with the appropriation at hand would be to endeavor to check the spread of the insect. By a provision of the act, individuals and communities are compelled to aid in the fight against the pest on their estates and in their localities, to the amount of a certain per cent of their taxable property. The plan of the work was to destroy and prevent the ravages of the pest on private residential property, and in order to prevent the spread of the moths, roadsides in forests and wastelands were cleared and the trees were banded and sprayed. It was impossible to do anything



OUTLINE MAP OF NEW ENGLAND STATES.

The shaded portions indicate approximately the regions known to be infested by the Gypsy Moth, December 1, 1906. Scouting of unexplored territory by the United States Department of Agriculture is still in progress, and it is possible that some additional territory will be found to be infested.

PLATE V.

Female gypsy moths laying eggs. The branch on which they are was cut from a tree near Mashapaug Pond. In among the straw of the bird's nest can also be seen the empty pupa cases and a number of cast skins of the caterpillars. If one looks closely two male moths may be observed at the left.

for trees in the woodlands themselves. In 1905 and 1906, therefore, large areas of such woodlands and parts of some of the larger parks were stripped, and thousands of trees, especially pines, were destroyed and had to be cut down and turned into cord wood. Pine Banks Park, for instance, last summer presented a depressing spectacle of standing dead pines, stripped and dead deciduous trees, and piles of cord wood derived from trees already cut down. Lynn Woods Park had to be closed to the public, and it is stated on good authority that the caterpillars became so numerous on the rails of the electric roads, in one place at least, as to interfere with the running of the cars because of the presence of their crushed bodies.

History of the Gypsy Moth in Rhode Island.

(See map of Providence and vicinity).

The first appearance of the gypsy moth in this country outside of Massachusetts was in the city of Providence. This colony was discovered in 1901. According to a pamphlet published by the Rhode Island State Board of Agriculture and written by Mr. Southwick, the following is a history of its discovery:

Mr. Prescott D. Reynolds was the first person to discover and report the appearance of the moth in America outside of Massachusetts. He is one of the several amateur entomologists of Providence, and is particularly interested in the collection of moths and butterflies. He discovered a few female moths, and their very characteristic patches of eggs, Wednesday, July 31, 1901, on some shade trees in Courtland street. They were on the trunks of the trees close to the edge of the sidewalk and liable to be rubbed off at any time. The specimens were carried to Mr. Southwick, who identified them as the gypsy moth. Mr. George A. Stockwell, Secretary of the R. I. State Board of Agriculture, was notified, and on his recommendation Mr. Southwick went to Boston to confer with the Massachusetts State Board of Agriculture, which had in charge the gypsy moth work in that State. Secretary Stockwell of this Board and Mr. Kirkland accompanied Mr. Southwick back to Providence in order to investi-

gate the extent of this new infestation. They were met at the depot by Secretary George A. Stockwell and by Mr. Reynolds, and proceeded at once to the place where the insect had been found. It was thought from the appearance of the infested district that the insect had been established about two years and that the area comprised from five to ten acres.

A conference was held with acting Mayor William K. Reynolds and a number of members of the city council at the city hall, as a result of which Mr. Southwick was authorized to spend $25 in further investigation. Through the kind co-operation of Mr. Kirkland, the services of Mr. F. H. Mosher, an experienced assistant on the Massachusetts gypsy moth work, were secured for the purpose of ascertaining the full extent of the colony. Later the city increased the appropriation for the work to one hundred dollars ($100), and the city of Providence was quite thoroughly scouted. August 24, Mr. Southwick reported that the scouting had revealed a much larger territory than was at first suspected, and that the moth was spread between Westminster and Broadway from Courtland street to Harkness street, and between Westminster and Cranston streets from Bridgham street to Dexter street. It was also found along the west side of Elmwood from Sprague street to Columbus street, and on Lexington and Adelaide avenues; and another small section was bounded by Broad and Taylor streets and Harvard and Comstock avenues. There were two small outbreaks on Prairie avenue and on Thurber's avenue, and one on Huntington avenue. Around Benedict Pond a decidedly bad condition was found. Mr. Southwick surmised that it extended over the city line into Cranston, but no scouting could be done there because the appropriation under which this work was done confined it to the city of Providence. The sections mentioned are indicated in diagonal black lines on the accompanying map.

History of the Agitation for a Campaign Against the Gypsy Moth in Rhode Island.

The writer regrets that he has not had time to look very fully into the history of what was done previous to last fall with a view of securing legislation to suppress or exterminate the gypsy moth. A number of the reports of the State Board of Agriculture call attention to the presence of the insect and advocate appropriations and legislative measures to deal with the situation. Two years ago a bill carrying an appropriation of about three thousand dollars was introduced by John G. Clarke, Sec. of the State Board of Agriculture, but failed to secure the necessary support for passage. From time to time a number of private citizens have been calling the attention of the State Board of Agriculture and some of the members of the legislature to the need of such legislation. Private enterprise has also been active looking toward conducting a fight against the gypsy moth. Notable among these was the Providence Tree Protection Society. This society was organized at the instance of Mr. Alfred Stone, who has taken an active interest in this as well as other lines of legislation dealing with insect pests. This organization raised quite a little sum of money and engaged men to destroy the elm leaf-beetle, gypsy moth, and other tree pests. Last spring the residue of the funds of this society was turned over to the Park Board and by them used in combating the gypsy moth in the neighborhood of Roger Williams Park.

The history of the work which led up to the appropriations of last year, being more recent, has been more easily ascertained. At a meeting of the Rhode Island Horticultural Society at Providence in November, 1905, Dr. Wheeler, Director of the Rhode Island Experiment Station, related his experiences on a trip through the infested regions of Massachusetts and called the attention of the members of that society to the danger which threatened the horticultural interests of Rhode Island from the gypsy moth colony which had become established in Providence. Subsequent to this meeting, Dr. Wheeler

arranged a meeting of representatives of various agricultural societies of the State and organized what was called an Agricultural Federation. This included the following societies:

State Board of Agriculture,
Washington County Agricultural Society,
Newport County Agricultural Society,
Rhode Island Horticultural Society,
Newport Horticultural Society,
Florists' and Gardeners' Club,
Rhode Island Poultry Association,
State Grange.

At a meeting of this federation a committee consisting of Judge Bliss and Dr. Wheeler was appointed to draw up an act for the General Assembly. The act so framed was introduced in the House the second day of the session, taken up under the suspension of rules and passed. It provided for an appropriation of $5,000 and a commission, composed of one man from each county, which should serve without pay, and which should have power to hire a superintendent to have immediate charge of the work. This act failed of passage in the Senate, that body framing a new act similar to the one now in operation. The two houses failed to agree on a compromise act until the very last days of the session when the resolution now in force was finally passed. The final passage of this bill was undoubtedly due to the hearty support of the idea that some legislative action should be taken by a great number of Rhode Island citizens, including members of the various organizations already named, as well as that of the Rhode Island League for Rural Progress, which, through its president, Hon. R. G. Hazard, and its executive committee, strongly urged the passage of some act which should deal adequately with the problem.

At a meeting of this League, held in April, and just before the close of the session of the Assembly, Supt. A. H. Kirkland of Boston was present and gave an address on the gypsy moth problem. A number

of the members of the General Assembly, including some of the members of the finance committees, were present, and after the address the situation was quite thoroughly discussed. There is no doubt that this also had considerable influence in strengthening the knowledge of the situation which led to the final passage of the resolutions.

While this agitation was going on in the State, its people also took an active part in the campaign for a national appropriation to aid the various infested states in their campaign. Our representatives in Congress were urged by various citizens to support the measures which were introduced by Senator Roberts of Massachusetts. Dr. Wheeler of the Experiment Station attended a hearing before the House committee which had this bill under consideration. At that time it called for an exterminative policy of the gypsy and brown-tail moths and failed to meet with the approval of the committee. W. H. Bowker and Representative Roberts of Massachusetts, and Dr. Wheeler of this State, then held a consultation in which it was decided to introduce a new bill omitting mention of the brown-tail moth and providing for an appropriation to establish a quarantine of the gypsy moth. Representative Roberts and Dr. Wheeler waited on Dr. L. O. Howard, Entomologist of the Department of Agriculture, to see if the bill would meet with the approval of that department. Secretary Wilson was also interviewed, and he gave assurance that he would support the measure. The result was the passage of an act by Congress which started in the House by calling for an appropriation of $65,000 and which finally passed both houses carrying an appropriation of $82,000.

Dr. Wheeler, as secretary of the State Agricultural Federation, also brought this movement to the attention of the agricultural organizations of all the New England States, of New York, New Jersey, Pennsylvania, Delaware, and Maryland, pointed out the danger to these States if the moth should be allowed to spread, and asked their aid in securing the appropriation. Forces were also joined with the Southern States which desired an appropriation for the control of the cattle tick, to the mutual advantage of both interests.

No special effort has been made to obtain accounts from people in the infested district of Providence, but the following have come in, in answer to inquiries sent. Personal visits to places in the infested district will more than verify any of these statements.

"The gypsy moth was brought to my notice by seeing the men sent out by the city taking them from a few apple trees in my yard. I think the men came about once in two weeks for four or five times, and each time they destroyed all they could find and at the last of it the men overturned about ten cord of cord wood that was piled up in my yard and found the moths in large quantities. I think the men did a good job of it. I also think if the pests are followed as close another year and people generally take hold and destroy their share that it will be money and time well expended." (Thomas W. Early, 283 Thurber's Avenue.)

"I do not think we have had them for more than three or four seasons. They have attacked all of our trees and shrubs. I presume they would have stripped the trees of their foliage had we not had them sprayed. I most certainly think they would defoliate all the trees if allowed to spread. We have had our clothing stained by them, and have found them very uncomfortable and disagreeable, and I think they would increase very rapidly if measures were not taken to exterminate them. We had our trees sprayed twice last spring and summer, but I do not think it did much good excepting that it cost us considerable money. The last set of men tore down the burlaps and trimmed the trees, so I hope we shall not have quite as many as last year." (Delia D. Cole.)

"A year ago last spring I noticed a great number of long shells on the quince trees, but didn't notice many worms that year. Last spring there seemed to be another lot of the same kind of shells on all the trees, and after that there were a great many worms. They would spin down from the trees and get on the house. We could not go out of doors without getting them onto us. I think if the men that came around hadn't taken such good care of the trees, the leaves of all the trees would have been eaten. I think we will have just the trouble here as they did in Boston if they are not watched very close. (Mrs. Smith, 16 Autumn Street.)

"We have noticed the caterpillars for the past two years, during which they attacked six trees. They were so numerous that they stripped trees of their leaves and prevented them from bearing fruit. They also dropped from them on people passing under, and we have found them on lace curtains and other cloth in the house. The walks were covered and we couldn't sit under the trees

at any time. As we have been disturbed quite a considerable for the past two years, I think that the people of Providence ought to try to prevent the insect from destroying trees throughout the State." (C. E. Price, 179 Sherburn Street.)

Occurrence in Other States.

(See map of New England States, and of Infested district around Stonington, Conn).

Connecticut

A colony of the moths was discovered last year in the neighborhood of Stonington. Fortunately that State has a standing fund for dealing with insect pests, and prompt measures were at once taken to exterminate it. It is located in a section of brush-land where it is rather difficult to find, but on the other hand the infested area is very small, covering approximately only one square mile, and it is also hedged about by water in such a way that the moth can escape only in one direction. A letter from Dr. Britton, quoted on page 70, says that he has the situation well in hand and hopes to exterminate the colony in the near future.

New Hampshire.

In 1905, Professor Sanderson of the New Hampshire Agricultural College secured an expert scout from the Massachusetts force. He, together with Professor Sanderson's assistant, scouted the towns along the coast to and including the city of Portsmouth. The pest was found in nearly all of these towns. Professor Sanderson says that the infestation in New Hampshire is probably confined to Rockingham county, east of the Western Division of the Boston and Maine Railroad.

Maine.

During the present fall, notice has been received that there is a very small colony in the southeastern corner of Maine in the towns

of Kittery, Elliot, and York. A stray egg cluster was also found at the Soldiers' Home at Togus, near Augusta. The United States Bureau of Entomology is now scouting the region from Kittery to Portland, and it is possible that further infestations may be found.

Occurrence of the Gypsy Moth in Foreign Countries.

The gypsy moth is a well-known and seriously injurious insect throughout a large section of the northern part of the Eastern Hemisphere. It is very prevalent throughout all the countries of continental Europe. It is found as far north as Stockholm in Sweden, and St. Petersburg in Russia, across temperate Asia to China and Japan, south into Ceylon and Northern Africa. The insect has probably been present in all of these regions, with the exception of Northern Africa, for many centuries, and its parasitic enemies are quite numerous and active. For this reason it is seldom that it maintains itself to an extremely injurious extent for a great number of years, but nevertheless there are frequent outbreaks in which large sections of the country are devastated. Only a few years ago a section of Southern Russia and neighboring countries as large as the states bordering on the Atlantic in this country was thoroughly devastated causing untold loss. A special report of the Massachusetts State Board of Agriculture on the gypsy moth quotes numerous records from the entomological literature of Europe, showing that, long before entomology was studied to any extent, records of outbreaks of this insect have been made. A number of years for the past two centuries have been known as "caterpillar years" in various sections of Europe from the fact that the gypsy moth was extremely prevalent. In recent years the insect has received a great deal of attention from European entomologists, and one of the problems which the modern forestry policies of Germany and other European countries have to consider is that of preventing damage to woodlands from the gypsy moth.

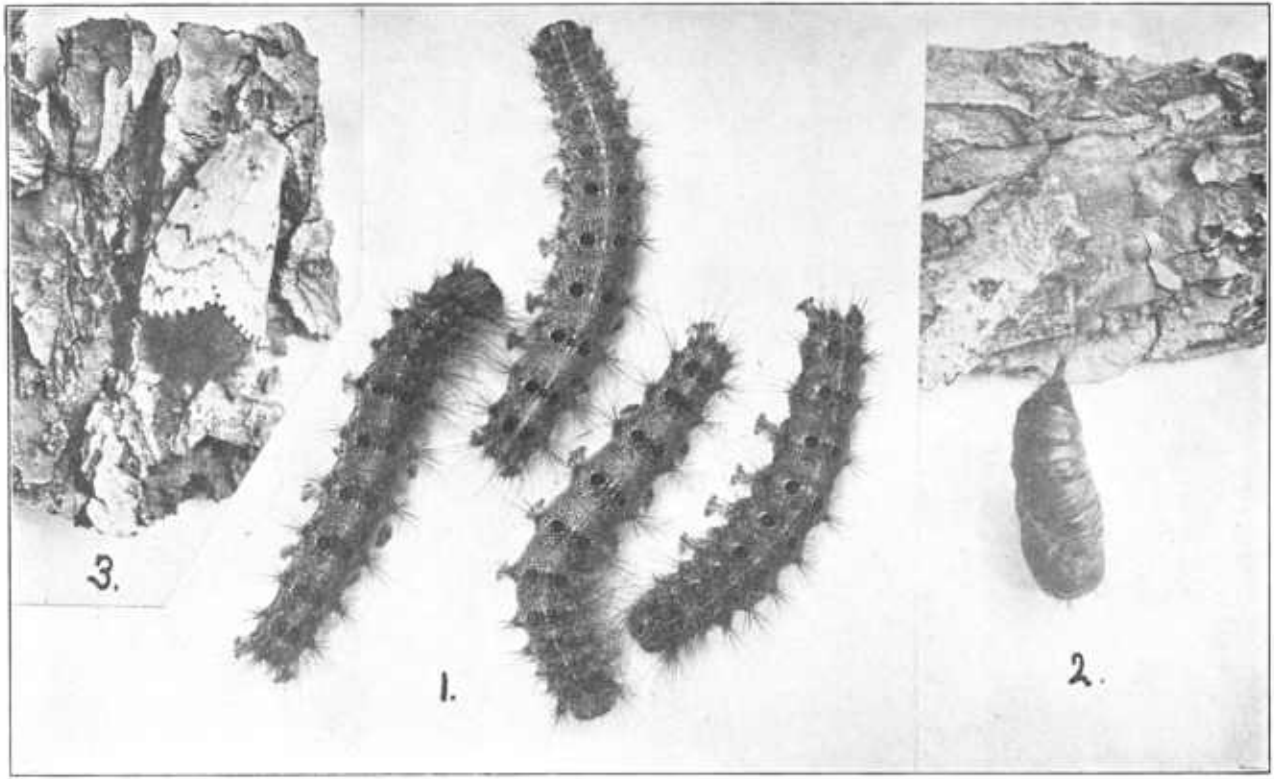


PLATE IV.

1. Full-grown caterpillars of gypsy moth. 2. Pupa. 3. Female gypsy moth laying eggs. After Kirkland.

A Short Description of the Gypsy Moth.

The following description will, so far as practicable, avoid the use of technical terms, and the best pictures obtainable will be added as illustrations. Still it is realized that many who are unacquainted with the study of entomology and unaccustomed to determining species of insects from printed or oral descriptions will find it more or less difficult to decide whether a specimen found is really the gypsy moth or some other insect which has always been with us. Those who may be so perplexed can compare the specimens found with the life history mounts placed in the libraries of the State, or, what will be still better, send the insect to the office of the Commissioner at the Rhode Island College, Kingston. It need not be urged upon anyone, in view of the destructive character of this insect and its vast possibilities for continued and untold damage if it once gets a widely scattered foothold in our waste forest lands, to watch carefully all insects suspected and to report their presence and send specimens if necessary. The experiences in Massachusetts, related in part elsewhere in this report, should be sufficient warning to the people in Rhode Island not to suffer this pest to escape their vigilance.

The eggs of the gypsy moth are laid in elongated, flattened clusters, about one-third to one inch by one-half to one and one-half inches. Each cluster contains from three hundred to six hundred eggs. The eggs are nearly globular, and one-twentieth of an inch in diameter. In color they are of a dark salmon when first laid, but if fertile, they darken considerably on the development of the embryo, which is fully formed in about three weeks. The eggs are closely packed, and held together by a kind of cementing material. The cluster is covered over with yellow hairs which are detached from the body of the female while depositing them. This covering and the cementing material render the clusters quite impervious to water from rain or snow, or to injury from extremes of temperature. As indicated by the dimensions already given, the egg clusters are generally of an elongated shape. They vary, however, considerably with the location in which they are found and the circumstances attending the

laying. On twigs and on weeds where a narrow surface must be utilized, the clusters are much more elongated than on surfaces where lateral extension is possible. Again, owing to crowding of other females in the act of laying, or of disturbance, interruption, or peculiar conformation of the object upon which the insect is located, the egg clusters may assume various shapes, which may be described as "bunched," "elongated," "crooked," or "partially interrupted." When first laid the egg cluster is of a yellowish color, but after exposure to the elements for some time the color fades to a considerable extent. When the insect is numerous egg clusters are frequently laid on top of each other, and it is not an unusual occurrence to find dead females covered up by clusters laid by other females which commenced egg-laying after the earlier ones had completed the process.

The gypsy moth exercises but very little choice as to where its eggs shall be deposited. When the caterpillars are numerous they scatter a good deal toward the end of their period of growth, and in such cases one may expect to find the eggs in almost any conceivable place: under stones, rubbish and leaves, on the trunks and branches of trees, in bird nests, and under fence rails, etc. Last fall clusters were frequently found in large quantities by the workers in stovepipes, tin cans, and other rubbish on dump heaps.

As is partly indicated by its range, the eggs of the gypsy moth caterpillar are quite resistent to extremes in temperature. Experiments in Massachusetts have shown that clusters can be heated to from 130 to 140 degrees and that the eggs still hatch readily. Clusters were subjected to a temperature of 20 degrees below zero without any apparent diminution in the percentage of hatched eggs. Rapid changes between these extremes also seemed to have but little deleterious effect on the eggs.

Observations have indicated that the eggs of the gypsy moth hatch about a week or ten days earlier in this State than in Massachusetts. In Providence this year the first caterpillars were observed shortly after the middle of April. It takes from three to five days for all the eggs of a cluster to hatch, and the caterpillars remain

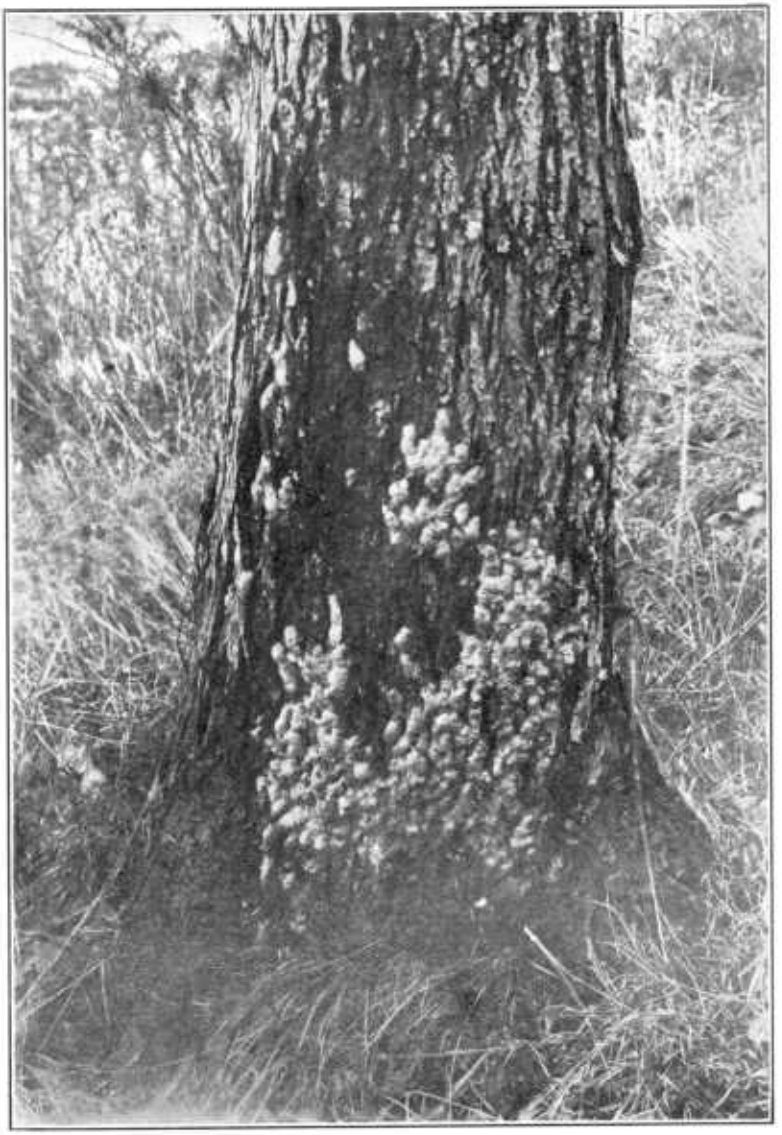


PLATE VI.

Egg clusters at the base of an oak tree between the railroad track and Benedict street in Cranston. This is but a small part of one tree in this locality, and there are caterpillars enough in the egg clusters on this single tree to strip all the trees in the neighborhood next summer.

grouped on the cluster for two or three days after hatching before they start out to seek food. At this time the young caterpillar is about one-sixteenth of an inch in length, hairy, and with a relatively large black head. The first stage lasts from eight to ten days, after which it sheds its skin and increases somewhat in size and changes slightly in color. During its lifetime the caterpillar passes through six or seven such changes or moults. It changes in color each time, and of course becomes larger. Not until the fifth moult, however, do we get the characteristic markings by which anyone can distinguish it. At this time the caterpillar is of a dark ashen or mottled gray color and covered with dark brown and grayish hairs which grow from tubercles along the sides and back. Along the back are two rows of colored tubercles. *The first five pair of these are blue, and the following six pair are crimson.* The head is smaller and less prominent in comparison with the body than it was in the earlier stages, and is of a dark gray to black mottled color. The full-grown caterpillar measures from one and one-half to two and a quarter inches in length.

The caterpillar becomes full-grown in about ten weeks, and then usually seeks some partially protected place in which to spin a flimsy cocoon and change into a pupa. In this, as in the egg-laying, the insect shows the same carelessness in choice of location, and often chooses exposed sides of tree-trunks or the roughened bark on the under side of the larger branches. When the caterpillars are numerous they frequently migrate to rubbish in the region surrounding the infested trees and pupate in old tin cans, boxes, barrels, old stovepipes, etc., as has been indicated by the finding of egg clusters in these places. At this time the female pupa is usually much larger than the male and therefore readily distinguished. The pupæ of both male and female are dark brown in color, with a few scattering yellow hairs, and to the uninitiated they may look a great deal like the pupæ of many other moths. The insect remains in the chrysalid, or pupa stage, for ten or twelve days.

In the *imago*, or adult stage, the insects differ greatly, so much so, as compared with other insects, that it gave rise to the Latin specific

name of *dispar*. The male is much smaller and more slender bodied than the female, and flies actively in the daytime with a fluttering, zigzag motion. In size it measures about one and one-half inches across the wings. In color it varies from a light to a dark brown, with irregular, more or less broken markings of a darker shade across the forewings. The hind wings are a little lighter in shade than the forewings and not so distinctly marked. Along the outer edge of each wing is a border of lighter color interrupted by darker spots or blotches. The antennæ are quite prominent and feathery. The segments of the abdomen are marked with narrow bands of a slightly lighter shade than the ground color.

The female is white or creamy in color with dark bands or markings across the wings similar to those of the male. It measures about two inches across the wings. Its body is much larger than that of the male and covered with hairs of a light yellowish color. The yellow shade is darker and more pronounced on the under side and toward the tip of the abdomen. The antennæ are black in color and much smaller than those of the male. Although apparently supplied with abundant wing surface, the female never uses her wings except to flutter a little and break her fall should she be dislodged from a position some distance from the ground. On this characteristic of the female depends one of the reasons why it is possible to exterminate the gypsy moth in restricted localities. There is no possibility of the insect spreading by the flying female.

The Means of Spreading.

Of itself the insect is spread principally by the migrating of the caterpillars from one place to another. This is usually very slow unless the insects become so numerous as to destroy all food material. In such cases the caterpillars will probably migrate for quite a little distance each year. Distribution in this way would be comparatively slow at best and the greatest danger comes from the transportation of the insects by man and other agencies. It is probable that animals passing through woods infested with the gypsy moth may intercept

PLATE VII.

Searching for gypsy moth egg clusters under a fence by the aid of a small hand mirror.

some of the spinning caterpillars and carry them to other regions. The great danger, however, in this mode of distribution comes from the transportation on vehicles, such as wagons, automobiles, electric cars, etc., from places where the caterpillars are numerous to uninfested regions. The writer recollects driving through a piece of woodland in Massachusetts last summer where the caterpillars were spinning down from the trees in which the foliage had been more or less destroyed. A number of these fell into the carriage and on those who were in it, and upon emerging from the woods it was necessary to stop and look the vehicle and our clothing over carefully to destroy the caterpillars which we had carried with us. Distribution in this way is also comparatively uncertain, as there are many chances that caterpillars will be scattered singly in places far apart and thus be unable to found a new colony.

The greatest danger comes from intentional scattering of the insect and from the transportation of egg clusters on lumber, wood, building material, bricks, stones, lawn furniture, rubbish, etc. In such cases a large number of individuals hatch out, and although the beginning of a colony which originates in this way may be feeble, owing to inbreeding and other unfavorable circumstances, yet the chances for a start in this manner are very good.

Superintendent Kirkland, who closely observed the insect when its presence was first noticed in Providence, states that the several colonies were apparently of the same age, and that conditions pointed strongly to the supposition that the pest had been introduced by some irresponsible or malicious person. Another supposition is that the moth was introduced in the form of egg clusters on lawn furniture which was carried into Providence by people removing from Boston.

Whichever of these theories regarding the introduction of the pest into Rhode Island is correct, there is no doubt that many of the outlying colonies have originated from the primary colonies through the transportation of egg clusters. For this reason it is of the utmost importance that great care should be exercised not to remove any material whatsoever that is liable to carry the egg clusters without

first making sure that none are present. There should be a provision in the law that notice must be given to the Commissioner of the gypsy moth work, and permission for the removal of material in gypsy moth districts be obtained before such material is carried away. It is also essential that all public-spirited citizens should be on the lookout for the careless or intentional violation of such laws in order that information may be given the Commissioner in charge before the spreading is accomplished.

Prospect for Control of the Gypsy Moth by Parasitic Enemies and Fungous Diseases.

During the first campaign in Massachusetts against the gypsy moth, from 1889 or 1900, the appropriations were made with the idea of exterminating the insect, and for this reason but little attention was given to parasitic enemies, aside from studying such of our native parasites as seemed to be developing the habit of affecting the gypsy moth. In this study it was learned that a great many of our native hymenopterous and dipterous parasites, as well as predaceous insects of various kinds, were useful in reducing the numbers of the moth to some extent. It is evident, however, from the history of the insect in this country and from the fact that it is now thirty-six years since it was introduced, that the combined forces of all the insect, bird, and other enemies which the gypsy moth may have are insufficient to keep the insect within bounds.

The history of the insect in Europe, while it shows that it is very destructive over certain sections at intervals, also shows that its invasions are very similar to those of our tussock moth, army worm, and tent caterpillar in this country; namely, that it will increase for a period of a year or two, and then its parasitic enemies, finding plenty of food, will have increased in a large degree and will cause the destruction of nearly all the moths. This balance of an insect and its foes was destroyed for the gypsy moth when it was introduced in this country, and it has been having things very much its own way because its enemies were left behind.

Recent appropriations in Massachusetts and also an appropriation by the Department of Agriculture at Washington have been made with a view of introducing to this country some of the insects which prey on the gypsy moth in Europe. A fund, extending over three years and amounting to something over $30,000, is made available by these combined appropriations. Superintendent Kirkland of the Massachusetts work has placed the bulk of his appropriations in the hands of Dr. L. O. Howard of the National Department of Agriculture, for the purpose of carrying out the provisions for which this appropriation was made. Dr. Howard is one of the foremost authorities on parasitic enemies of insects and has a wide acquaintance with entomologists of Europe, so that the work has been placed in excellent hands. Through a visit which he made to Europe last year, and through the plans which he then set in motion, shipments of parasitized gypsy and brown-tail moths are continually being made when ever material is found.

In this effort to introduce parasites almost the entire country of Europe is being scoured to secure them. A Tachina fly, *Tachina larvarum*, which is known to be very destructive to the caterpillar of the gypsy moth in Europe, has been introduced, and next year an attempt will be made to propagate it extensively. Attempts have also been made to introduce a predaceous beetle, *Calosoma sycophanta*, related to our predaceous beetles of the same genus in this country, but, unlike them, more efficient in destroying caterpillars which infest trees. So far living specimens of this beetle have not survived the passage of the Atlantic but it is hoped another year that specimens will be successfully imported. Dr. Howard has made arrangements with a great many entomologists and collectors throughout Italy, Austria, Germany, and France to be on the lookout for material which may be of use to us, and to send it on to Superintendent Kirkland at Boston.

In all this work great care is being taken not to introduce secondary parasites; that is, parasites which feed on the primary parasites in which we are interested. An insectary and laboratory has been

established in one of the infested regions near Boston, and here the work of rearing and studying the parasites will be carried on. It is the intention of the Massachusetts authorities to send out broadcast to all the infested regions such parasites as may be found efficient, and the people of Rhode Island may hope, therefore, that, should anything be discovered, the benefit thereof will accrue to the interest of our citizens as well as to those of neighboring States. However, as anyone will note by reading the letters of Superintendent Kirkland, Dr. L. O. Howard, and others, which are copied in whole or in part on pages 64 to 73, the problem of securing efficient parasites is still unsolved, and it is not wise for the people of this State to wait until such a time as it may be determined whether insect parasites can be introduced or not, because the cost of taking up the work of suppression at such a time will be far larger than will be the cost of keeping it in suppression, or even exterminating it, at the present time.

Importance of the Gypsy Moth as Compared with Other Insect Pests Common in the State.

It has seemed to a number of people during the past year or two, and it is often expressed, that the gypsy moth has not been unduly destructive, and many feel that the elm-leaf beetle, the scale, the tussock-moth, the elm-caterpillar, etc., are much more serious pests at present than the gypsy moth. This latter statement was undoubtedly true for this season. The elm-leaf beetle especially, in many parts of Providence as well as other cities in the State, was very destructive during the past summer, defoliating trees in many cases. The egg clusters of the tussock moth have also been very numerous, and as they are likely to be even more readily seen than those of the gypsy moth, people are led to think that this insect is much more numerous than the pest against which the State Commissioner has been working. These conditions, however, should not mislead anyone. The above-mentioned insects are natives of this country, or, with the exception of the San José scale, they have been here long enough to have a num-

PLATE VIII.

Using a medium long-handled brush for creosoting egg clusters on trees some distance from the ground.

ber of parasites which serve to keep them in check. They are also subject to various diseases, and their vitality and life history is such that large numbers often perish owing to unfavorable climatic conditions.

This desirable balance between the insect and its foes thus established has already been briefly explained on page 30, and need not be repeated here. The gypsy moth has no such checks, and there are no natural means to keep it from increasing until its food supply is exhausted; and this is not a condition which promises any relief, as it has an omnivorous appetite in contradistinction to the other insects mentioned, which are limited to one or a few food plants. If not fought by man, therefore, it is capable of increasing until it assumes the proportions of a veritable plague, and that it will do this is amply illustrated by its history in Massachusetts.

Among the specimens sent into the office or pointed out to the Commissioner or his inspectors as gypsy or brown-tail moths the past season the following insects may be mentioned. Many of them bear no resemblance to the pest in question, and some of them would perhaps not have attracted attention if it had not been for the interest aroused in plant pests. Some of the species mentioned, notably the elm-caterpillar, elm-leaf beetle, and white-marked tussock-moth, were very numerous and perhaps for that reason were suspected of being the notorious pests. Occasionally people seemed to think that we ought to deal with all injurious insects, and sometimes insisted that a certain insect must be the gypsy moth because it was very injurious, and that we should look after it.

American dagger,	*Acronycta americana.*
Hickory tiger-moth,	*Halisidota caryæ.*
Salt-marsh caterpillar,	*Estigmene acræa.*
Elm-leaf beetle,	*Galerucella luteola.*
Forest tent-caterpillar,	*Clisiocampa disstria.*
Apple tent-caterpillar,	*Clisiocampa americana.*
White-marked tussock-moth,	*Hemerocampa leucostigma.*

Spiny elm caterpillar, Larva of mourning cloak butterfly,	*Euvanessa antiopa.*
The yellow-necked caterpillar,	*Datana ministra.*
The red-humped prominent,	*Œdemasia concinna.*
Fall web-worm,	*Hyphantria cunea.*
Willow saw-fly,	*Cimbex americana.*
Currant-worm,	*Nematus ribesii.*
Io moth (larva),	*Automeris io.*
Tomato-worm,	*Protoparce celeus.*
Celery worm,	*Papilio asterias.*
Common swallow-tail butterfly,	*Papillio turnus.*
Pandorus sphinx,	*Philampelus pandorus.*
Long-tailed ichneumon (from Providence),	*Thalessa lunator.*
Horned corydalus, "Dobson" "hellgramite,"	*Corydalis cornuta.*
Canker-worms,	*Paleacrita vernata.* *Anisopteryx pometaria.*
Climbing cut-worm,	*Carneades scandens.*
Maple phenacoccus,	*Phenacoccus acericola.*
Promethea moth (cocoon),	*Callosamia promethea.*
Cecropia moth,	*Samia cecropia.*

Methods of Fightihg the Gypsy Moth.

During the many years that the State of Massachusetts has fought the gypsy moth, its habits and life history have been quite fully recorded. No insect has ever been so closely studied, and the published results of such studies, issued by the Massachusetts State Board of Agriculture, are monumental in their thoroughness and extent. This is especially true of a special report issued in 1897 and written by E. A. Forbush and Dr. Fernald. All known methods of fighting insects were tried, and everything in the way of apparatus and materials which had ever been used for similar purposes were obtained

and tested. The result is that we have in this country at the present time a far more complete knowledge of this insect than is found in its native country, and the methods of fighting and the remedies to be used are far in advance of those employed in Europe in their efficiency.

Destroying the Egg Clusters.

Since the insect remains for eight or nine months of the year in the egg stage and the eggs are grouped in fairly conspicuous egg clusters, their destruction becomes the most practical and economical way of dealing with the insect. The drawbacks to this method are that, on account of the secretive habits of the insect, egg clusters are sometimes laid in places where they are not easily found and therefore escape the notice of workmen and inspectors. Eggs are often scattered during the laying and fall on the ground. Experiments have shown that such eggs are often hatched, and caterpillars appear to the astonishment of the workmen who supposed that they had destroyed every egg cluster in the place.

European methods of dealing with the egg clusters consisted in removing them from the places where they were laid and burning them, and in applying coal tar and oils to them. The former method is undesirable because in removing the eggs the workman is liable to scatter a number of them, which, as indicated above, may hatch the following season. Coal tar and oils are fairly efficient, but somewhat difficult of application, and the method of applying creosote, which has been developed in this country, is far more practicable. When an egg cluster is thoroughly saturated with this substance there is little chance that any of the eggs will escape destruction. Burning the eggs where found has also been tried, but has been found inefficient because the hairy covering of the cluster seems to protect the eggs underneath very thoroughly and an intense amount of heat is necessary to destroy all the eggs. Pure creosote gives no readily noticeable stain or discoloration after drying, and in order that the workers and inspectors may know what nests have been treated, it is custom-

ary to incorporate with the creosote, tar or lampblack. Clusters painted with such a mixture show by their discoloration for a long time afterwards that they have been treated. The usual proportion of such a mixture is 85 per cent. pure creosote and 15 per cent. of coal tar; or 6 gallons of creosote and one pound of lampblack. The former mixture is perhaps the best for warm weather; the latter for the winter months. Another more complicated mixture is sometimes recommended, but it is doubtful if it is more efficient than the ones mentioned above. It is made up as follows: Creosote oil, 50 per cent.; carbolic acid, 20 per cent.; spirits of turpentine, 20 per cent., and coal tar, 10 per cent.

Burlapping.

Even with the most careful work a few egg clusters and eggs are liable to escape and the resulting larvæ must be caught in some way. In studying the habits of the caterpillars it was found that after having reached the fourth moult they feed only at night and seek some hiding place during the daytime. According to the Massachusetts report, the habits of the insect in this respect have been found to be quite regular. Individual caterpillars have been watched and found to ascend the tree to feed from seven to eight o'clock at night, and to return to the same hiding place that they previously occupied the following morning between four and five o'clock. It has been noticed also that if a tree presents no suitable hiding place, such as very rough bark or hollows in the branches or stems, the caterpillar usually descends to the ground to hide under rubbish and other convenient shelter around the base of the tree. To take advantage of this habit, a band of burlap eight or ten inches wide is

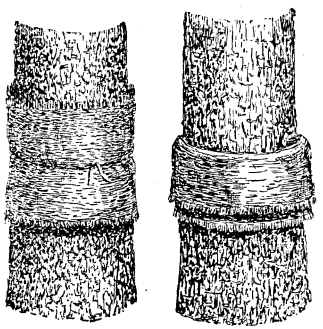


Fig. 2. BURLAP BANDS.

PLATE IX.

An illustration of how the men have to climb through the tops of large elms in order to search for and destroy the egg clusters of the gypsy moth.

tied around the tree about four feet from the ground, or lower if necessitated by the presence of branches below this height.

The method is for the workman to carry over his shoulder a roll or loose bundle of the burlap already cut to the desired width. In coming to a tree he passes the end around the tree until the cloth laps a few inches. The required quantity is cut off from the rest of the bundle and a stout string is passed around the tree along the middle of the band and tied. The upper part of the burlap band is then folded over the lower. The appearance of the burlap and the operations as described are illustrated in Plates X, XI, and Fig. 2.

When the caterpillars have reached the state when they begin to descend to these burlap bands for shelter, men are sent around once a week, or oftener if the insects are plentiful, to raise the bands and destroy the caterpillars found underneath them. The destruction is accomplished, if the caterpillars are few, by cutting them in two with a knife, or, if numerous, by crushing them with a small wooden spatula.

The burlapping method is very efficient, and a prominent Massachusetts worker is quoted as saying that, if extermination should be arrived at in that State, the last caterpillar would be caught under a burlap band. In order that the burlap work shall be effective all other hiding places in the trees must be done away with. Holes in the trunk or branches must be filled up; loose bark removed; and broken, hollow, or ragged branches must be sawed off close to the stem. If the tree is an old one or otherwise has very rough bark, in the crevices of which the caterpillars can find hiding places, it is sometimes necessary to remove the rough exterior by scraping the trunk and larger branches. In short, the tree must be thoroughly groomed according to the best rules of æsthetic care and pruning.

Owing to the large amount of work required to put on and care for the burlaps, and the expense of the material, this method is of practical application only on trees in orchards, ornamental and shade tree plantings, and in open woods, and is of no real value in tangled brush-land whether found in the woods or in ill-kept backyards.

A fuller description of the various lines and methods of work which are supplementary to the principal methods of creosoting and burlapping will be discussed under the head of "Cleaning Work."

The presence of the burlaps on the trees in Providence occasioned not a little variety of conjectures as to their purpose and use. In spite of the fact that explanations were given in a bulletin issued during the summer and distributed through the entire infested district, and also by newspaper articles, a great many supposed that the bands of burlap had been treated with a poisonous substance which in some more or less mysterious way should kill the caterpillars when they came in contact with it. Others thought that the burlaps were designed as barriers to prevent the ascent of the caterpillars, and were very much chagrined, and probably commented on what they took to be a foolish procedure, when they noticed that the caterpillars sought refuge under the bands and had but very little trouble in passing over them to the foliage above. Many thought that they would improve upon the method used by the State and tacked the burlap bands to the trees, or painted them with tar, whitewash, or oil paints, all of which, as anyone who understands their use will realize, defeated the real purpose for which they were put on.

The burlapping work is essential, and in spite of the fact that a large share of the expense of an exterminative policy comes from the use of the burlaps, nevertheless, their efficiency, as already intimated, is such that it is essential to use them.

Spraying.

This method of combating, so common in the treatment of many other injurious leaf-eating insects, is of secondary importance in dealing with the gypsy moth because of its rather peculiar ability to resist the action of poisons. Experiments in the Massachusetts work have shown that a gypsy moth caterpillar can eat a quantity of poison which would usually destroy several caterpillars of other insects. Chemical analyses have shown that a gypsy moth caterpillar may

PLATE X.

Photograph showing method of wrapping a strip of burlap around a tree and cutting it off with a knife.

have a quantity of poison in his system sufficient to destroy any other insect and still be in good health and complete its metamorphosis. It has even been found that poison remains in the system of the insect while it passes through the pupa and into the imago form. Nevertheless, if spraying is used while the caterpillars are young, it will serve to materially check their numbers. Even at this time it is necessary to use a quantity of poison which is much in excess of that ordinarily employed, and the operation is therefore quite expensive. The plan of work this summer has been to use spraying only where there was danger of the trees being defoliated by the caterpillars, or where it was necessary to destroy as many as possible before they could be scattered to other sections. This was especially true where they were found around places where carriages and wagons were stored for short periods, or where street cars passed under or came in contact with the foliage of infested trees.

When spraying was first begun, ten pounds of lead arsenate were used per hundred gallons of water. This quantity was increased, as the caterpillars grew larger, until about fifteen pounds were used when the caterpillars were half-grown. It may be said in passing that lead arsenate was first used as an insecticide in the first Massachusetts campaign against the gypsy moth, and has been found to be the best spray remedy for the pest. No other poison can be applied to the trees in sufficient quantities to destroy the caterpillars without injuring the foliage to a considerable extent. Paris green, for instance, if applied of sufficient strength to destroy the gypsy moth caterpillars, would seriously burn the foliage of most of our shade and fruit trees, even with the addition of a quantity of slaked lime.

Certain rules and principles are kept in mind in the application of insecticides; one is, that the spray must be applied in a very fine mist-like form. This is accomplished by using a good, up-to-date Vermorel nozzle and a pump through which a sufficient pressure can be secured to thoroughly break up the spray as it passes through the orifice. It is essential that this pressure amount to from 75 to 125 pounds per square inch.

Many ask questions as to whether the spraying of trees is not liable to poison the fruit, if they are fruit trees, or to deposit sufficient of the poisonous substance on the foliage and on the grass underneath to be injurious to animals which may happen to eat of the foliage or grass, or even to fall off and poison people who may happen to be under the trees. A little reasoning will satisfy anyone that there is no danger to people from the distribution of the poison from the foliage. There is also no danger from poisoning by fruit which has been sprayed, unless possibly when the spraying has been done shortly before the fruit is ripe and ready to use. There have been a great many experiments made to determine whether there is enough of poison on the grass underneath sprayed trees to be injurious to cattle. One of the most convincing of these is mentioned in the report of the Massachusetts State Board of Agriculture in which a dairyman purchased the hay from an orchard which was sprayed several times during the season and fed it to his cattle. No injurious effects whatever resulted.

It is desirable to avoid spraying fruit trees while in blossom because it is liable to prevent the proper fertilization of the flowers, and because it is injurious to the bees which may visit the trees at this time.

Banding with Sticky Substances, Etc.

In some cases where trees have been cleared of insect pests and it is desired to protect them from re-infestation by caterpillars migrating from neighboring infested trees, banding of the trees with some sticky material which will act as a barrier is successfully practiced. This is also efficient in protecting trees from certain insects, notably the canker worms, which pupate in the ground, and the wingless females of which have to reach the foliage of the trees by climbing to deposit their eggs. It should be noted, however, that much of the banding which one notices on trees throughout the country is a waste of time and money because no insects are present against which the remedy is useful, and because the method is such that it would be inefficient in any case.

PLATE XI.

Photograph showing method of tying the burlap strips on the trees. The knot is about to be completed.

Among the substances used are coal tar, printers' ink, raupenleim, wagon grease, tanglefoot, soft soap, and sticky fly-paper. There are also various forms of mechanical contrivances including cotton and wool waste bands, designed to catch or prevent the progress of ascending insects. Among the sticky substances, coal tar, printers' ink, and wagon grease should not be applied directly to the bark. When utilized they should be applied to a strip of tarred paper or other impervious material wrapped around and tacked or otherwise fastened to the tree. In order to prevent the insects from crawling under this band it is necessary to either smooth off the bark underneath or else apply a band of waste cotton or other material which will fill up the crevices in the bark. Sticky fly-paper lasts but a short time and is of but little use unless the bark is smoothed over underneath the band or a layer of cotton is placed underneath as indicated above. Raupenleim (caterpillar glue) is a German preparation similar to tanglefoot which is made in this country, but not so safe to use as it is more likely to injure the trees. The last-mentioned substance is the best and cheapest remedy on the market. It can be applied directly to the bark with little if any danger of injuring the tree. It is customary to smooth the bark, if very rough where the band is to be placed, to save material, and to apply with a comb-like instrument having flat, flexible teeth. A flat, wooden spatula can be used for applying the material, if the special instrument is not at hand.

Mechanical contrivances made of tin, zinc, and copper are sometimes seen, but their use is restricted and is seldom advisable on account of the large initial expense of putting them on, and the close watching which they must have to see that they do not injure the trees or fail to afford the protection desired.

GENERAL CLEANING WORK.

In addition to creosoting, burlapping, and spraying, a large amount of general cleaning work is necessary. A campaign for the extermination of the gypsy moth is hindered by the presence of rubbish, ill-kept fences and outhouses, and decaying, ill-pruned, and poorly

kept trees. In fact, the gypsy moth is favored by just such conditions as our civic improvement societies are deprecating in their campaign for better, cleaner, healthier, and more beautiful cities and towns. If its presence, then, can make our property owners realize that they must improve the conditions of their premises according to the principles of the civic improvement ideas, it will be a slight recompense for the vast amount of trouble and outlay which its presence entails.

Ground Work.

Under this term are included searching picket and board fences, stone walls, shrubs, weeds, rocks, foundation and other parts of buildings, rubbish, and, in fact, objects of every conceivable kind, for the presence of egg clusters of scattered insects. It also includes the gathering and burning of rubbish, burning over brush-land, etc., for the purpose of destroying the egg clusters or caterpillars of the gypsy moth.

It may be of interest to note in this connection that this process of burning must be intelligently directed. Burning over brush-land in the winter time is of but little avail, as the fire which can be produced is not of sufficient intensity to destroy many of the eggs. By experiments in Massachusetts it has been found that egg clusters on rocks, to which sufficient heat had been applied to crack them, have partially escaped destruction. It is therefore necessary, except in cases where a great deal of combustible material together with egg clusters can be gotten together in a pile, to burn over the ground shortly after the insects have been hatched. This applies also to "firing" stone walls. For some of this work an apparatus for burning crude oil and producing an intense flame, such as illustrated in Plate XXI, can be applied to advantage, and it will be necessary for the State to procure some of these for the work next spring.

In connection with this work it may be well to call attention to the fact that the depositing of rubbish and refuse of all kinds should be thoroughly controlled with a view of placing it where it would be

PLATE XII.

Photograph showing burlap bands around trees. Many of the trees illustrated have branched trunks, and in such cases it is necessary to put a strip around each large branch.

of the least menace in providing a harboring place for the gypsy moth. Specified dump heaps should therefore be designated in different parts of the city. These should be kept clear of trees and shrubbery on which the gypsy moth can feed, and all rubbish should be carted to these places. In some of the rubbish heaps gone over in Providence this year, stovepipes, tin cans, old carpets, old shoes, discarded boxes and birdhouses, have been found more or less plastered with the eggs of the gypsy moth which have come from neighboring trees and sought hiding places in them.

The Care of Trees.

There is in our State a very commendable love of trees, and many of the Rhode Island estates, streets, avenues, and roadsides are planted or lined with magnificent elms and other trees which bear evidence of the practical results of this sentiment and are well worthy the pride that is taken in them. That this love of the beautiful in trees and plantings has not as yet become wholly subservient to intelligent and rational direction is occasionally sadly in evidence. Trees which have every advantage of suitable soil and location and which are fully capable of maintaining a healthy growth in our climate are rotten at the core, infested with borers and other insects, unsymmetrical, and often ready to fall over and cause damage to neighboring property, or even injury to persons in passing, at the onslaught of the first strong wind. The reasons for this are manifold, but the principal ones are unintelligent or careless pruning and its many undesirable consequences, hacking off limbs by men stringing electric wires, neglect of wounds caused by pruning or the accidental breaking off of branches, the barking of trunks by the gnawing of horses or by wheels and whiffletrees of carriages in charge of careless drivers. Whatever may be the injury, dire consequences to the tree result and render it liable to speedy destruction by borers and other insects and by plant-destroying fungi and bacteria.

The overcrowding of trees is another condition which interferes with their fullest development, and therefore with the best effect of

the plantation in which they are placed. We frequently see along our streets three or four trees crowded into a space which should be occupied by one or two, and the same is also true of many private estates. The result is too dense a shade, an undue struggle for light and air among the tree-tops, and finally, the gradual decline and death of the weaker trees and an unsymmetrical development of the remainder.

From the standpoint of our work against the gypsy moth these conditions present various problems. The weakened trees seem to invite the attack of all kinds of insect enemies. The mutilated and hollow branches and trunks afford excellent hiding places for the caterpillars of the gypsy moth and defeat the purpose of the improvised hiding places put on in the form of burlap bands. The insect lays its eggs in the cavities and hollows of these trees and sometimes renders it absolutely impossible for the workers to find them in the fall and winter for the purpose of creosoting them.

The superabundance of trees in various places and the presence of crippled and diseased trees increases not only the difficulty of cleaning and spraying, but also adds unnecessary expense. Our workmen come across some tree on the lawn or in the yard which is all but dead. It is badly decayed, its trunk and branches are infested with borers, and it barely maintains life and leaf-surface enough to sustain a few such pests as the gypsy moth—and this pest finds a safe retreat in the hollow trunk and branches of such trees from which it is next to impossible to eradicate it. Again the men find a street tree crowded by its neighbor, barked by horses and passing vehicles, diseased and borer-infested like the other, and barely able to send a single dilapidated branch where its leaves can get air and sunlight. Such trees ought to be cut down, but right here is where we encounter difficulties due to the tree-loving sentiment which has already been mentioned. These trees have grown to be almost a part of the grounds and the homes upon them. Their history is entwined with many recollections and associations, and people refuse to have destroyed trees which needlessly add many dollars to the

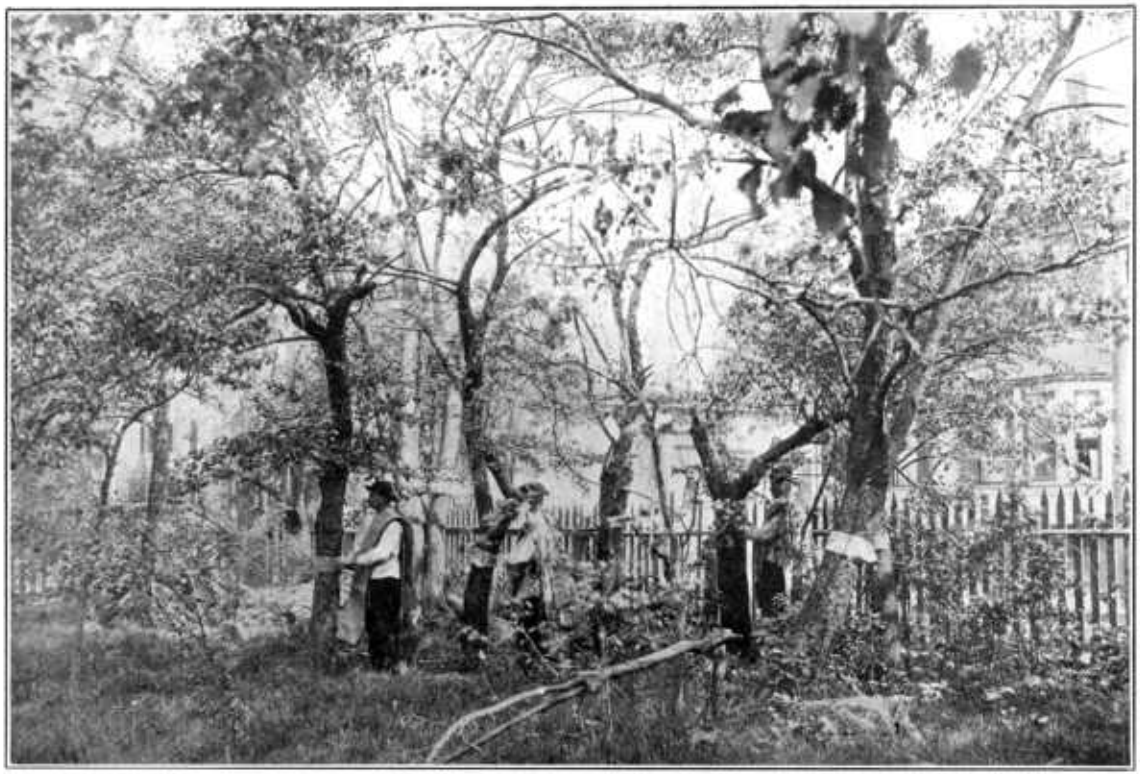


PLATE XIII.

This photograph shows the large amount of work and the heavy expense of burlapping vacant lots which are covered with a tangled mass of trees.

expense of the gypsy moth campaign. Many useless trees must therefore be repaired, so far as possible, as well as those that are worth the expense. Hollows and cavities must be covered up with zinc patches to prevent the caterpillars from hiding in them, or to prevent caterpillars, from eggs which may be laid in them, from emerging. Ragged, rotten stumps of branches, monuments of the pruner's ignorance or carelessness, must be sawed off; rough bark must be removed, and miscellaneous other work, too varied to mention in detail and yet necessary for the repair or proper grooming of the trees, must be done in order that a thorough campaign against the gypsy moth may be carried out.

The much discussed individuality and independence of the Rhode Islander also comes into evidence at times, largely through a misunderstanding of the work. One man orders our workmen off his premises because he says there are no gypsy moths present. Another says he is not going to have the homely rags (burlaps) on his trees. If the pests come on his premises he is perfectly able to deal with them and will do so in his own way. Commendable as this spirit is in many cases, it interferes radically with our campaign. If the work is delayed until the average citizen becomes aware that the gypsy moth is present, the insect may have gotten such a strong foothold that it is difficult to eradicate. Scores of people were very much astonished this summer when they were told that they had colonies of gypsy moths of one or more years' standing on their premises. Again, the methods used by the State are such as have been found to be the most efficient by ten years' work and study in the Massachusetts campaign, and unless the property owner is willing to follow these, he is liable to waste his money without perhaps accomplishing the extermination of the insect.

In a great majority of cases, however, a desire to help the work along takes a form which is of the utmost value to the purpose in view. Nearly every property holder in the city, when our men have come around, has been more than willing to give every assistance in his power, and the State has been saved a great many dollars

throughout the summer by the very kind and cordial help which has thus been given to the work.

When this cleaning work is being performed the men are required to creosote all the egg clusters found, and this operation of course saves some future labor. It may also be said that a great deal of this repair of trees is of great value in improving street and lawn plantations, and it would perhaps not be regarded as oppressive if part at least of the expense, equivalent to a portion of the value of the improvements which ensue, were charged to the city or to the individual on whose property the trees may be located. In this way some additional funds could be obtained for what will otherwise seem very expensive and difficult work.

All this work requires excellent supervision and good workmen, and for some of the larger trees, expert climbers are necessary. Quite a supply of tools, ladders, repair materials, etc., must also be provided.

The Work in Rhode Island in Brief.

The appropriation under which the campaign for the suppression of the gypsy and brown-tail moths has been carried on became available at the close of the last session of the General Assembly, the latter part of April. The writer received his appointment to take charge of the work April 25, but on account of previous engagements could not start active operations until the 27th. Plans, however, were considered at once, and as soon as possible a trip was made to Boston for the purpose of conferring with Supt. Kirkland regarding the methods of work which were to be pursued. It was recognized that one of the first essentials was to secure a man to act as foreman and to have immediate charge in the field, who should be thoroughly acquainted with all the forms of the insects and with the different lines of work which had been found efficient in suppressing or exterminating them. On the recommendation of Mr. Kirkland and of Mr. Rogers, Mr. John Sweeney of Woburn was secured. Mr. Sweeney has had nearly ten years' experience in the work in Massachusetts,

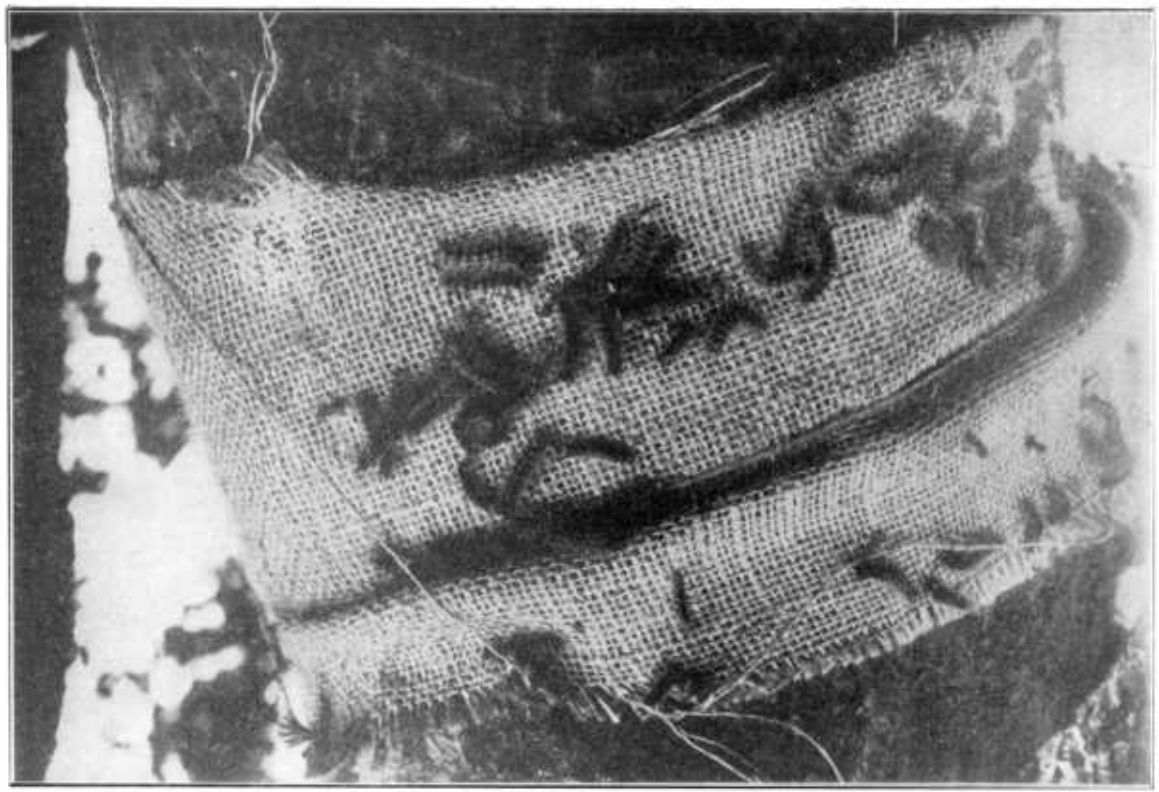


PLATE XIV.

An illustration to show how the gypsy moth caterpillars cluster underneath and between the folds of the burlap bands placed in the trees.

and last year was sent to New Hampshire to scout the infested territory of that State for Professor Sanderson, who is in charge of the work.

During the latter half of April the Park Board had made a small appropriation which they placed in the hands of Supt. Fitts of the park system. Mr. Fitts placed a number of men under the charge of Mr. C. Abbott Davis, Curator of the Museum, who has taken quite an active interest in the agitation for the suppression of the insect. Mr. Davis and his men hurriedly went over the district in the Elmwood section north of the park, and one or two other places in the city, to creosote the egg clusters. In this way a very large number of egg clusters were destroyed, but on account of the hurried nature of the work and the inexperience of the men only a part of the clusters present were destroyed, and plenty of the caterpillars appeared throughout the section during the summer.

One of the greatest difficulties at the beginning of such work as was to be undertaken is to obtain the men necessary for carrying it out. The ordinary workman has but a very faint idea of the methods to be employed and of the necessity for being thorough in his work. Fortunately, when the State funds became available, the men whom Mr. Davis had had were turned over for the State campaign, and arrangements were also made with Messrs. George Johnson & Son, florists, and Mr. Edward Armstrong to furnish a certain number of men and to take charge of limited districts of the infested territory. These parties had had considerable experience in the past in treating the gypsy moth for private parties, and some of the men whom they furnished also had had a little experience in the work to be undertaken. The wisdom of securing a foreman trained in the methods of work and in how to look for the moth in all its forms at once became apparent. Sections of the city which were supposed to be free from infestation were found to have moth colonies of two or more years' standing, and when less experienced men would pass a section as containing but a few egg clusters, large and healthy colonies of the insect would be found.

It was soon discovered that the most complete report available at the time fell far short of indicating the full extent of the infestation or the seriousness of the situation. It was realized almost from the beginning that the $5,100 appropriated by the General Assembly would not be adequate to much more than keep the insect in check throughout the infested region, and possibly to reduce it in numbers in some of the worst infested places.

The work as planned may be separated into two lines: One was to destroy as many of the caterpillars as possible through the direct work under the State appropriation; the other, to educate the people of the infested district, and also of the State, by furnishing information regarding the presence of the pest, how to identify it, and how each individual citizen could help in the work.

For the destruction of the moth, creosoting the egg clusters has been found to be the most economical method. At the time the appropriation became available, however, the eggs had been hatching for ten days or two weeks and there was but very little time left in which to attempt to destroy the insect in this way. Some effectual work was done, nevertheless, and the insect was somewhat reduced in numbers in some parts of the infested territory.

The next best method of dealing with the insect is that of burlapping the trees. Plans for this work were immediately gotten under way, and before the end of the season it is estimated that between sixty and seventy thousand trees were provided with the burlap bands. Approximately 45,000 yards of the burlap strips were used, and for several weeks during the height of the caterpillar season it took thirty men to go over the burlapped section to destroy the caterpillars which were found under the burlaps. Approximately twelve square miles of Providence territory were covered in this work. As the season advanced more and more infested territory was found, and since the cleaning work has been carried on in cooperation with the Department of Agriculture at Washington during the late summer and fall, the known infested territory has more than doubled.

PLATE XV.

A backyard containing deciduous and evergreen trees, herbaceous plants, and a number of wooden fences and outhouses which give the gypsy moth plenty of opportunities to hide its egg clusters and render it very expensive to eradicate the insect.

One of the objects which was ever kept in view was to prevent the moth from spreading to other uninfested sections. For this purpose, and also to prevent defoliation, a number of very badly infested trees were sprayed in different parts of the city. Owing to the smallness of the funds at hand, property owners were requested to spray the trees in their yards when it seemed necessary, the State taking care of the street trees. Such requests were cheerfully complied with except in a very few cases where parties could not well afford to go to the expense of hiring the work done. Special attention was paid to trees on the street from which there was danger of the caterpillars spinning down on passing vehicles, and in the vicinity of icehouses, livery stables, lumber yards, and places in general where a great deal of teaming is done, and where vehicles of various kinds are sometimes left standing until there is danger of their having caterpillars on them which could be carried to uninfested sections of the city.

While this work was going on a bulletin descriptive of the gypsy and brown-tail moths and the methods of fighting them was being prepared, and in May an edition of ten thousand copies was printed. This bulletin was distributed freely in the infested sections of Providence and to a small mailing list covering the whole State. Articles for the press were also prepared explaining the nature and extent of the infestation; the character and appearance of the insects and the methods of work to be used against them. In this newspaper work a number of other people took part and usually furnished information which was timely and correct and not designed to mislead the public. Occasionally, however, something would be sent in which was flagrantly incorrect, or only partly true and designed to mislead the readers both as to the work done and as to the extent of the infestation. It is a pleasure to record that the statements in this line, statements in fact which none but the most ignorant would credit, found no acceptance with any of the Rhode Island newspapers, so far as the writer knows.

A large share of the appropriation having been used up by the end

of July, a plan for co-operating with the United States Department of Agriculture was arranged with Mr. Rogers, the New England representative of the National Bureau of Entomology, whereby he was to take over the men which the State had had to his pay-roll, and whereby the State should furnish the tools and materials necessary for prosecuting the cleaning work which would begin in August and continue for the remainder of the season. Since that time from twelve to sixteen men have been steadily at work in the infested regions of Providence. The burlap bands were removed and burned; egg clusters have been searched for and creosoted; rubbish has been cleared up and burned; brush-land has been cut over; dead trees have been cut down; hollow trees have been repaired by placing zinc patches over the openings. In this way it is hoped that the number of insects for another year will be greatly decreased; and where opportunities have been given for thoroughly cleaning up rubbish, destroying old trees, and repairing those that could be saved, the work for another year will be reduced and simplified. For a fuller account of the United States work see letter from Mr. Rogers on page 67.

With the assistance of Professor John Barlow of the College, who has very kindly and efficiently aided in some of the entomological work, large exhibit cases, one each of the gypsy and brown-tail moths, were prepared and sent to the county fairs at Portsmouth and West Kingston. In order to more fully acquaint the people with the appearance of the gypsy moth, specimens of the various stages, from the egg through the caterpillar, pupa, and adult or imago form, both male and female, have been secured, and from these Professor Barlow has prepared a number of life history mounts in Riker cases. One of these life history mounts will be sent to every library in the State, and the librarians have already assured us that they will be placed in conspicuous positions where they can be readily examined by anyone interested. A number of excellent lantern-slides have been secured, and the writer is prepared to give illustrated talks on the gypsy and brown-tail moths and their history in this country. In addition, a

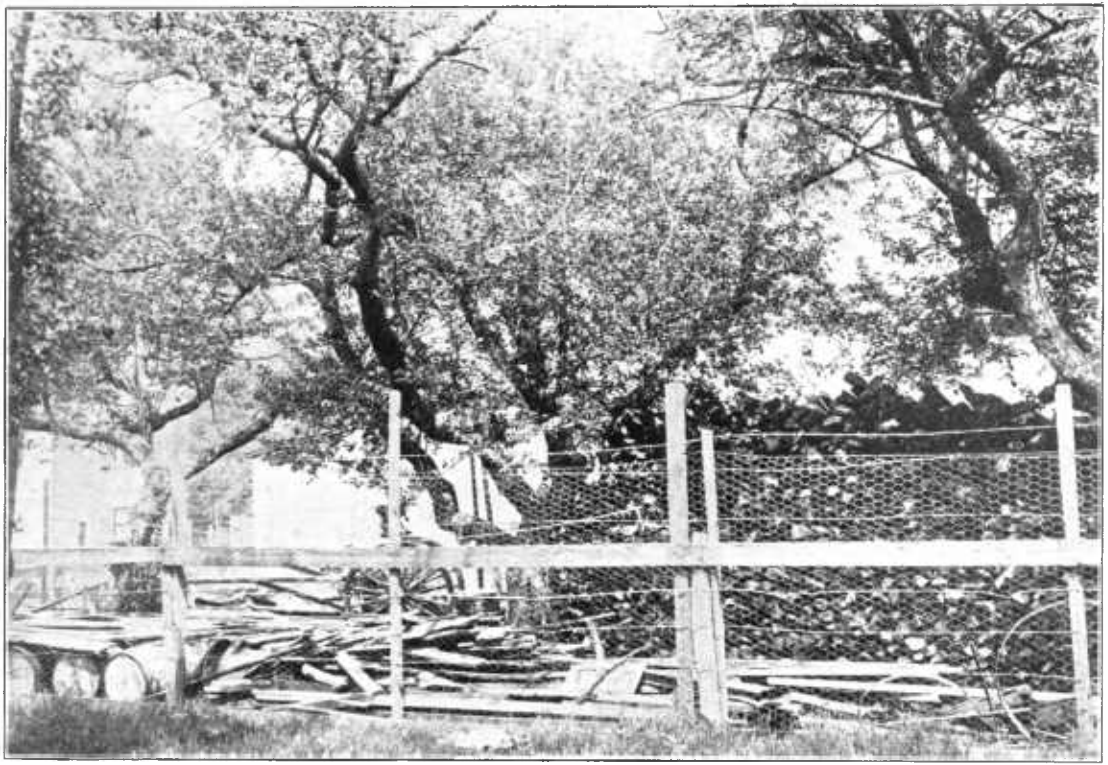


PLATE XVI.

Cut showing an infested apple tree in a wood-yard. Such places are prolific sources of gypsy moth distribution.

cardboard poster, 11 by 14 inches, has been printed. This gives photographs of some of the important stages of both the gypsy and brown-tail moths, with suggestions for fighting them. Two thousand copies of this have been printed and it is planned to send one to every public school, post office, railroad depot, and to public offices or places in the State where they are likely to be hung up and attract attention. It is hoped in this way to so thoroughly arouse the people to a knowledge of the necessity of being on the lookout for the insects, and of reporting them when found, that we shall, before the end of another year, know every place where the insect occurs and be able to deal with it in a thorough manner.

In the investigation of reports of the presence of the gypsy and brown-tail moths much time was spent and scores of places were visited, but in no case, except where the report came from the vicinity of Providence, was either of the pests present.

In the expenditure of the funds it was ever kept in mind that every dollar possible should be spent in actual work against the insect in the field and in sending out such information as should best acquaint the people of the State with the problem before them and how each individual could help meet it. For this reason an office in Providence was dispensed with and the office facilities of the Extension Department at the Rhode Island College were utilized. Many other minor aids in prosecuting the work were dispensed with for the same reason.

No technical or experimental study or work has been attempted for two reasons: first, that already mentioned, that the money was needed for actual field work; and, second, such work has been thoroughly prosecuted practically under conditions similar to ours in Massachusetts and is still being continued in that State, so that there has been no immediate need of any special efforts in that line in Rhode Island.

The following summarized account of expenditures will give an idea of the different ways in which the funds have been expended and total amount used. It will be noted that a small part of the appropriation is still available, and this is held subject to use in providing

tools and material according to our arrangements with the United States authorities.

Labor	$2,960 03
Tools	121 68
Burlap and twine	515 62
Paint, creosote, etc	24 05
Badges	16 20
Express, freight, and draying	42 20
Repairs (tools and carts)	7 90
Store house	30 00
Educational work,—printing, photographing for bulletins, circulars and reports, etc	381 93
Office expenses, including telephone, telegraph, office furniture, stenographer, and stationery	167 34
Postage	12 20
Traveling expenses of Sweeney and Polk	32 69
John Barlow, preparing exhibits and life history mounts, and traveling expenses	60 75
Riker mounts and extra specimens for life history mounts	16 88
A. E. Stene, expenses, including meals, electric and railway fare, stage and hotel	136 36
	$4,525 83

Results of the Past Season's Work.

It is safe to assume that in the territory which was burlapped by the State during the past summer, and which has been gone over again this fall and winter by the men under the direction of Mr. Rogers, the number of insects has been very much reduced. It is probable that in this district there will not be enough insects left another year to seriously injure or even partially defoliate any of the trees. In fact, it was found that where, through the State work during the summer, trees were both burlapped and sprayed, few, and in one case no egg clusters were found by the men who went over the ground to do the creosoting. Through the burlap work also the presence of the insect was discovered in a great many places where no one suspected its presence. In the work conducted by Mr. Rogers during the winter, an area more than twice as large that bur-

PLATE XVII.

The remnants of an old orchard infested by various kinds of insects and plant diseases, and now of no practical benefit. As it stands, it is merely a harboring place for various insects and fungi, and especially for the gypsy and brown-tail moths. It gives no revenue and should be cut down in short order.

PLATE XVII.

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lapped last summer has been gone over to creosote the eggs and to clean up rubbish and to prepare the trees for next summer's burlapping. It is probable that this work also has reduced the number of possible caterpillars very greatly, but it is also probable that the insect has been overlooked in some places, and we must rely on the burlapping next summer to discover them.

In all the work of the year a close record of the work done and the places found infested has been kept so that we may know where to look for the caterpillars and egg clusters another season. It is also to be hoped that through the educational campaign which has been conducted during the past summer, people throughout the State have become thoroughly alive to the problem which this insect pest presents. In fact, instances of this interest have been evident throughout the summer. As has already been noted, a large number of insects has been sent in for identification. It is probable that in a great many cases where insects have been sent to us the people knew that they were not the gypsy moth, but an interest has been aroused in entomological study in general, and people are beginning to look about to learn more of their friends and foes in the insect world. This is as it should be, and may be put down as one of the few beneficial results from the presence of such a pest as the gypsy moth. Professor C. L. Marlatt of the Department of Agriculture at Washington has made careful estimates of the injuries of insect pests, and has found that they take annually a total of $600,000,000, or an average of ten per cent., from all the various crops which the farmer raises, to say nothing of the injury which they do to forest crops and to ornamental plantations. What other cause is there that produces a loss of ten per cent. in the income from various products which would receive so little study as insect pests have! The ignorance of the people in regard to insects occasionally amounts to a gullibility such that they are sometimes ready to buy the most absurd nostrums or pay for the application of the most useless remedies. Note the perennial bobbing up of the agents who have preparations with which all kinds of insects may be destroyed by simply inserting the remedy in a hole bored

in the tree, or the fact that the man who advertised a useless trap lantern, warned against by every experiment station in the country, became wealthy through its sale.

It is believed also that people generally take a hopeful view of the situation. There are a few perhaps who say, hopelessly, "What is the use of trying to fight the insect pests? They seem to appear more numerously each year, and even if a campaign against them can be prosecuted by one person, his neighbor will take no care of his crops and will thus propagate the pests." Or it is said that "the State may prosecute this work for a year or two and then drop it, and one might as well let the bugs have the trees first as last." A great majority, however, have offered to do all they can to help the matter along and to help take care of the trees on their own property. Such aid, of course, has been very gratifying as the State funds would otherwise have been entirely inadequate to keep the moth in check the past season.

The Probably Future Status of the Insect.

It may not be possible to predict accurately what the future status of the gypsy moth will be, should the work against it be dropped at the present time. It is reasonable to presume, however, that we ought to be able to judge something of its future by its past record since it was introduced into this country. The writer has no desire to magnify the disastrous results which will follow its unchecked propagation and spread in the State, but the following statements can readily be verified by anyone who will read the history of the insect in Massachusetts. This report has already related how the Massachusetts State Board of Agriculture fought the insect from 1890 to 1900, and while the appropriations were inadequate and did not always come at the time when most needed, the insect was so reduced in numbers and in the extent of territory infested that the people began to fancy themselves secure from future depredations and stopped the appropriations. Five years later they realized their mistake. The insect had again increased until it had become a

PLATE XVIII.

A tangle near the railroad tracks and freight yards at Olneyville. This was badly infested with the gypsy moth and had to be thoroughly cleared and burned over.

plague as serious as it was before the work against it commenced. Appropriations were again called for. The work was renewed and inspections soon revealed that the insect had not only increased to its former proportions in places where it had formerly been located, but, worst of all, it had spread over an area eight times the size of that previously infested, or an area equal to more than twice that of Rhode Island. By the aid of State and local appropriations amounting to three quarters of a million dollars the pest is now being held in check in thickly settled localities, but it is impossible to deal with it in woodlands and large parks, and hundreds of acres of such lands have been stripped during the past two years.

In Rhode Island we have as yet only a comparatively small area infested, but the colony is remarkably healthy and the area infested is large when we consider that the insect has been in the State not more than seven or eight years. If left unchecked, all possible evidence from its past history in this country points to the probability that it will only be a few years before the insect will have spread over the entire area of the State and westward into Connecticut. It will then be intrenched in some of our waste woodlands, where no money which the State will be able to raise can dislodge it. Individuals will then have to fight it at great expense, and our cities and towns will have to appropriate large sums of money to keep it in check in order to preserve the shade and ornamental trees and the parks and gardens. The aggregate of such appropriations and expenses for each year will undoubtedly be far greater than that now asked for with an exterminative policy in view, to say nothing of the personal loss and discomfort which our citizens will experience.

There is a hope for relief from parasitic enemies, but this is as yet only a hope. The insect has been in the country for thirty-six years, and none of our native parasites has been found able to keep it in check, and therefore but little can be expected from them. An effort is being made to introduce parasites from its native habitat, but whether these will successfully establish themselves is still entirely uncertain. And should they fail, our State would indeed be in

a serious predicament if it ceases to fight the gypsy moth now with the idea that parasites will keep it in check. The most hopeful of our entomologists say that it should be possible to establish the European parasites here, but whether that happy circumstance will be five years from now or a hundred years, it is absolutely impossible for them or anyone to predict.

Discussions as to the Future Policy of the State in Regard to the Gypsy Moth and the Need of Appropriations.

There seems to be almost a unanimous feeling throughout the State that something must be done to check the pest. There is some question as to whether a policy of suppression or one of extermination should be followed. The concensus of opinion of nearly all experts who know our conditions, as will be noted from their letters on pages 64 to 73, seems to be in favor of extermination, and from the experience and observations of last summer the writer is thoroughly in favor of this policy. The principal arguments in favor of extermination are, briefly, as follows: It will be far cheaper in the end. The area infested is still comparatively limited. Most of it is residential and therefore quite easily taken care of, and little of it is in tangled woodlands, where the insect is dislodged with difficulty. The State is some distance from the infested territory in Massachusetts, and can, therefore, be protected from reinfestation. The State of Massachusetts and the United States Government are pursuing a policy which should prevent its spread from Massachusetts, or reduce the possibility thereof to a minimum. Other States, notably Maine and New Hampshire, expect to follow an exterminative policy, and they are not so favorably situated as we are. It is the surest way of preventing the spread of the insect throughout the State.

The only arguments in favor of a policy of suppression are that it is easier to pursue and cheaper for the immediate future. According to the estimates of Supt. Kirkland, an exterminative policy will cost perhaps twenty-five per cent. more than one of suppression. It is possible that later parasites will keep the insect in check. In reply

PLATE XIX.

An illustration in the same territory as that given in the previous picture. This has been used as a dump, and many of the tin cans which are shown in the picture have from one to a dozen egg clusters of the gypsy moth within them. This is one of the most difficult places to deal with as the cans and rubbish must be raked together and the whole covered with oil and set afire. Even after this it must be closely watched, because a great many of the egg masses of the moth will not be destroyed even by intense heat.

to the latter argument, the reader is referred to the letter of Dr. Fernald quoted on page 65. It will be noted from this that we can have no definite assurance that the parasites can be established, and even if they are we can hope for no better conditions than those of Europe, where periodical outbreaks occur which result in great loss and discomfort to the sections invaded. The only other argument against the policy of extermination, and the one which may after all be the hardest to overcome, is that sufficient appropriations cannot be obtained to pursue the policy to a successful termination.

It may be asked whether a policy of extermination is practicable. In the reports of the gypsy moth work in Massachusetts we find accounts which show that many places were entirely cleared of the insects during the campaign which was carried on from 1891 to 1900. Lessons may also be learned from other countries with different insects. For instance, the potato beetle which is such a pest in this country has been repeatedly imported into Europe, but on account of the vigilance of the authorities there the writer is not aware that it has gotten a foothold anywhere. An article in one of the bulletins of the Department of Agriculture at Washington relates how at one time a small area in England became infested with the potato beetle. The authorities at once took the matter in hand, and by very heroic, and what seems to us very expensive methods also, the beetle was exterminated in two years. Accounts of similar experiences in Germany are related, and one man told the writer that in his boyhood days a colony was found in the neighborhood in which he lived. The authorities at once took charge of the matter and offered the school children a sum of money for bringing in the beetles. In this way, and with other methods which were used, the beetle was entirely exterminated in a very short time.

The Appropriation Needed for Another Year's Campaign.

On the recommendation of Supt. Kirkland, committees representing the Rhode Island Horticultural Society and the League of Im-

provement Societies in Rhode Island are planning to ask for an appropriation of $25,000 for the work. As this will undoubtedly seem to a great many an excessively large sum, it may not be out of the way in this report to give some of the reasons for such an increase of appropriations over that of last year.

The appropriation of $5,100, made at the close of the session of the General Assembly last spring, was fairly adequate for a policy of thorough suppression in the territory which was then known to be infested with the insect. It was entirely inadequate for the area which was found to be infested when the work was taken up, and while by rigid economy a larger territory than that originally known was gone over, it may be said that the work was scarcely more than sufficient to check the insect. The funds also lasted only until the first of August. After that the State has only provided money for educational work and for furnishing tools and materials to co-operate with the United States, which has supplied nearly all the funds since that time.

Another year a territory three times as large, and perhaps more, must be gone over, and the work should be much more thoroughly done than was possible this year. As the work increases in thoroughness it will become more and more exacting and the best men will have to be obtained, and this will necessitate slightly higher wages. This need of men who are of good character, and who will take pains to acquaint themselves with the work and to be conscientious and thorough in its execution, can not be overestimated. Inexperienced or careless men will often overlook a sufficient number of insects which, when allowed to propagate, will produce enough caterpillars to seriously injure the neighboring trees or spread the insect another year. Several foremen will also be necessary, and these must have a thorough knowledge of handling men and of the gypsy and brown-tail moths, and of methods of dealing with them, together with some general entomological and botanical knowledge, in order to be able to carry out intelligently directions from the Commissioner in charge. In short, the employment of men who know the business in hand

PLATE XX.

A discarded bird house, old stove-pipe, tin can, and a piece of carpet, from a dump heap in Providence, all more or less covered with egg clusters of the gypsy moth.

and have experience need not be further urged upon those who know how easily much money may be squandered uselessly through the ignorance and lack of judgment of those who execute the orders as well as those who have the work in charge. Such men are worthy of, and should have, honest and fair wages, and the State can not afford to treat them otherwise.

As will be noticed by the financial report, the burlap work has taken a very large part of the appropriation. This work should be repeated more thoroughly another year over an area fully three times as great. All the labor in cleaning, in creosoting egg clusters, and in scouting has been paid for this fall and winter by the United States Department of Agriculture, and it has spent a sum about equal to that which the State has used, making a total of nearly $10,000 spent up to the present time. We will undoubtedly obtain some help from the Department of Agriculture, if it secures the appropriation asked of Congress, again in the future, but new territory is being found in New Hampshire and Maine which will require its attention. By the terms of the Federal act, the United States work should be devoted largely to quarantine measures, leaving the suppression and extermination to State efforts. Furthermore, if reference be made to Dr. Howard's letter, on page 64, it will be noted that the expenditure of Government money depends to some extent on what each State does for itself.

It will be realized from this that we shall need three times as large an appropriation for the burlap work alone. In this connection it may be well to note that the expense of burlapping will be nearly as great in a place where but few caterpillars are found as where there are many. There are also various kinds of apparatus, notably, spraying machines and cyclone burners, which should be provided for another year.

More thorough work should be done in spraying, cleaning, and other lines of the campaign, and it would be a good thing to take some section, somewhat isolated from the rest of the infested territory, and

to test therein the possibility of rapid and thorough extermination of the pest by especially careful work with picked men.

A strenuous effort must be made to prevent further spreading of the insect, especially into our tangled woodlands. Some money must therefore be spent in a careful scouting from time to time along roadsides where automobiles, electric cars, and other vehicles are likely to scatter the caterpillars. Special care must be given to streets and places where vehicles are left standing near trees in the infested region, from whence the caterpillars may be carried. Close watch must also be kept of all material which may carry the egg clusters of the gypsy moth and which may be transported from the infested regions in the State or from Massachusetts. As people become more fully aware of the danger of the pest we may expect a larger number of reports of its presence, many, if not all, of which must be thoroughly investigated and their correctness verified.

Some of this work can be done by the Commissioner in charge, but he can not possibly do all, and he must have one or two inspectors with a good knowledge of the gypsy moth and a fair general entomological knowledge to assist in this work.

By a decidedly favorable vote of the people of the State at the last election, a large sum of money is to be expended in the establishment of a magnificient metropolitan park system for Providence and neighboring cities and towns. One of the established parks is now infested, and much of the land embraced in what is to be the metropolitan system also has colonies of the pest. Unless the moth is eradicated from these lands, some of the money to be spent for parks will be worse than wasted.

The educational campaign must be continued throughout the work. The people should be fully informed, through newspapers and through bulletins, circulars, exhibits, and lectures, of the nature of the insect; the territory infested; the progress of the campaign; and what each individual can do to help in the work. It is absolutely essential that the people shall have a full knowledge of the nature of the pest and how to identify it, in order that any new colonies may be quickly dis-

PLATE XXI.

Burning over infested brushland with cyclone burners. From Rep. of Mass. State Board of Agriculture.

covered and reported before they get a foothold. They should also be fully informed of how the funds are being expended.

A very small sum may possibly be devoted to the study of native parasitic enemies, to see if we have any which are more effective than those found in Massachusetts, and to introduce and test such as may be imported from Europe by Massachusetts and the Federal Government.

Several healthy colonies of the brown-tail moth have been discovered in the State, and while, for reasons to be given later, the fight against this insect should be left more largely to individual effort, such bulletins and circulars as will educate the people to help themselves should be written and widely distributed. There should also be a little money available to take care of any especially serious outbreaks which may occur at any time and which individuals can not stand the expense of suppressing. This may not require a great deal of money, but it is not safe to ignore the possibility of a need thereof entirely.

Relative Cost of a Campaign Against These Insect Pests.

Let us consider the proposition further from a financial point of view. There are probably in the city of Providence and vicinity 170,000 trees which will have to be dealt with another year. Taking this estimate as a basis, the appropriation asked for amounts to less than fifteen cents per tree. The people of Providence and vicinity should not object to a small addition to their taxes for the expenditure of this sum to protect their trees from defoliation and possible destruction, and the people outside the infested district should and will probably be glad to add their share to avert the spread of the pest over the whole State, and the much larger expenditures which must then be made from year to year merely to keep it in check. The expenditure required for extermination now is small compared to what we may expect will be required if the insect is not suppressed or exterminated.

Finally, the sum of money asked for is designed to last through one season of burlap and spraying work and two winters of creosoting of egg clusters and cleaning and up to the beginning of the burlap work in 1908. It was found in Massachusetts in the previous campaigns that the legislature acted too slowly on the annual appropriations, and consequently the work was delayed from year to year while awaiting funds for the work. As this delay occurred during the winter season when the most effective work can be done, much valuable time was lost, to say nothing of the loss incident to laying off the force of men and disorganizing the arrangements for the work.

An Efficient Law Required.

In connection with the appropriation a simple and efficient law should be enacted to cover essential points in relation to the work. This should declare the gypsy moth and the brown-tail moth public nuisances. It should provide for placing the work under the direction of one man, responsible to the Governor and the General Assembly. To him should be delegated power to deal with conditions and exigencies which may arise in such a way as to further the intent of the act.

The law should also provide for preventing further spread of the pest and for essential details of this provision, and for severe punishment of malicious persons who may seek to spread the insect.

Advice and Suggestions From Experts.

Whatever is done with our gypsy moth situation at the present time, it is bound to be somewhat expensive work for the State. We have also reached a point in the work at which some definite decision should be arrived at regarding what shall be the policy of the State, for at least the immediate future, in regard to the campaign against the pest. It is essential, therefore, that we should study carefully our conditions, and that we should get such expert advice and opinions as are available in regard to what should be done. With this

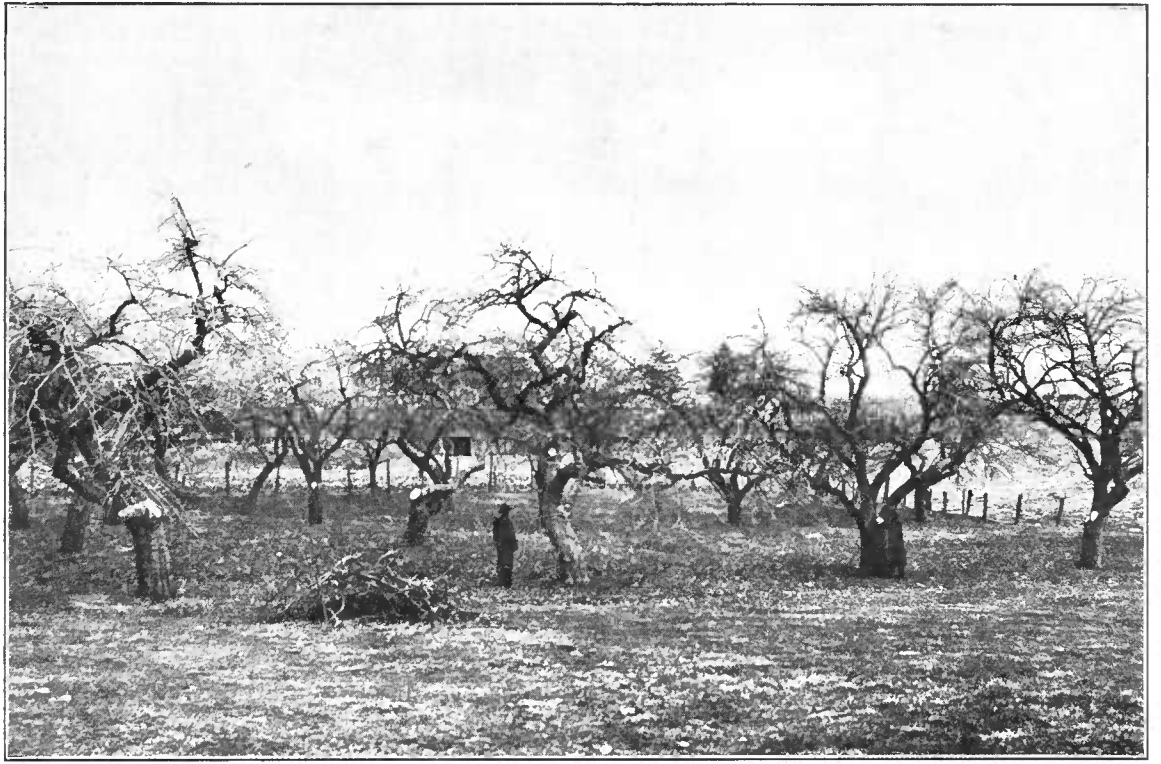

PLATE XXII.

Old apple orchard near Field and Cranston streets, Arlington, Rhode Island, badly infested with the gypsy moth. The photograph is intended to show the large amount of work and material which is necessary to patch up an old orchard in order to put it in shape for thorough work in eradicating the gypsy moth. All the white spots on the trees are large zinc patches. Only a portion of the orchard is shown, and by no means all of the zinc patches.

purpose in view, the writer has corresponded with Supt. Kirkland, the State entomologists in the different New England States and New York, and with Dr. L. O. Howard of the Department of Agriculture at Washington, regarding our situation, asking them to give us such statements as they thought pertinent in reply to questions asked.

In addition to inquiries concerning our own situation, questions were asked regarding the present condition in the States in which the moth is now found, and also as to what measures the different States would probably take in regard to the pest.

In writing to these parties the following questions were asked: It should be said in passing, however, that separate letters were dictated to each one addressed, and the questions were not always given in the same order and form, nor were all the questions sent to each one, consequently, the letters will not appear to answer the questions in the order here given, nor all of the questions.

"So far as you know of the condition in Rhode Island, do you think that the policy of the extermination will be cheaper in the end than one of suppression?"

"How much more expensive at the present time will a policy of extermination be over that of suppression, and how long should it take to exterminate the moth in Rhode Island?"

"If exterminated, have our people any assurance that the insect can be kept from invading the State again from the neighboring infested regions?"

"What chance is there for the development of parasitic enemies which will keep the moth in check more or less completely? If the parasites which we now have, and which may be imported, are promising results, can we hope for sufficient aid from them within a few years?"

"What is the total infested area in your State, and what are you intending to do in the way of securing legislative appropriations for combating the pest?"

"Is your State planning to do anything to assist in securing a national appropriation to help in the campaign against the gypsy moth?"

To those who know something of our conditions the writer made a brief statement of the present infested territory, and also requested that an estimate should be made of how much money would be necessary for our work next year.

By permission of the writers, the replies are here given almost in full. In two or three, parts which were in answer to specific questions asked regarding other matters, not pertinent to the present discussion, have been left out. So far as the replies to the above given questions are concerned, however, the letters are copied verbatim:

LETTER FROM DR. L. O. HOWARD, CHIEF OF BUREAU OF ENTOMOLOGY, U. S. DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

January 14, 1907.

My Dear Professor Stene:

I have yours of the 12th instant, and reply to your questions as follows:

(1) If the gypsy moth is exterminated in your State, I think it practicable to keep it from regaining a foothold.

(2) I have strong hopes that the European parasites we are now importing will hold the gypsy moth in check. I am unable to predict the time when the effect of their work will be observed. It may be soon—that is to say within a year or two—or it may be several years.

Yours very truly,

(Signed) L. O. HOWARD,

Chief of Bureau.

From another letter in regard to questions as to policy for Rhode Island and the help that we may obtain from the National Government, Dr. Howard writes as follows:

"I have your letter of the 2nd instant, and, to answer your last question first, I am thoroughly convinced that the best plan for you to work upon in your State is to endeavor to exterminate the gypsy moth, and not merely to control it. So long as you are isolated, as you appear to be, this is the only policy to be considered, in my opinion.

"As to the amount the general government can expend in your State, I am unable to inform you. The Secretary of Agriculture, in his estimates, has asked for a repetition of this year's appropriation, namely, $82,500. An effort will be made to have this very considerably increased, but it is absolutely impossible to predict the action of Congress in this regard. So you see it is impossible for me at the present time to estimate the amount the department will be able to spend in your State. I earnestly hope that the State will make a good appropriation,

PLATE XXIII.

An apple tree in the orchard shown in Plate 22. It shows how errors in pruning have resulted in large holes in the trunk and branches of the tree. These have been closed up with zinc patches described for the previous picture. The trunk of the tree is about two feet in diameter.

since extermination in Rhode Island seems to be possible, and I feel sure that the Secretary of Agriculture will be all the more willing to assist Rhode Island if it be shown that there is a strong effort for self-help there."

LETTER FROM DR. C. H. FERNALD, PROFESSOR OF ZOOLOGY, MASSACHUSETTS AGRICULTURAL COLLEGE.

AMHERST, MASS., January 12, 1907.

PROF. A. E. STENE.

DEAR SIR:—I am in receipt of your letter of the 7th asking for my opinion as to the best method of dealing with the gypsy moth in Rhode Island; whether it will be cheaper, everything considered, to enter immediately upon an exterminative policy than to adopt one of suppressiononly? After an experience of fifteen years with the gypsy moth in Massachusetts, and one summer in Europe, I am decidedly of the opinion that your State would better work for complete extermination rather than for suppression, for the following reasons:

1. Suppression, of course, means annual appropriations during all time, the amount of which I cannot estimate so closely for your State as for Massachusetts, where I am more familiar with the conditions. During the nineties, when we were fighting the gypsy moth in an infested territory about equal to that at present in your State, we found it very difficult to obtain sufficiently large appropriations from our legislature to carry on the work successfully. Some years we were able to secure an appropriation of $200,000, and with that amount we made good progress toward extermination. When we received $150,000 or $125,000 we still made some progress, but when we received only $75,000 it was apparent that we barely held the moth in check. I therefore think that the estimate of Mr. Kirkland of $25,000 for your next appropriation was a very conservative one.

You now have, as you write, an infested area of about twenty square miles, which is about one-fiftieth of your entire territory. If you simply work for suppression now, the insect will eventually spread over the entire State, and then the annual appropriations for suppression would amount to far more than would be necessary for extermination at the present time. You would be making the very same mistake that we made in this State.

2. The work for extermination would, for the first few years, cost more but as it went on the territory would become restricted and would soon be so limited in area that the cost would be much less than for suppressive measures on your present territory and would be constantly growing less.

3. The question of parasites is entirely problematical. No one can tell, at the present time, whether the parasites will become acclimated in this country,

but if they do, and accomplish their work as well as in Europe, even then the occasional destruction which the gypsy moth will cause in a comparatively short time will amount to far more than the cost of extermination at the present time. For an account of the work of this insect in Europe, where the parasites are holding them in check under the most natural conditions see the large report on the gypsy moth, 1897, pages 273 to 284, where you will find an account of the devastations of this moth in 1879-80 in Russia, where the climate conditions are more like those of New England than are most of the other parts of Europe. In the above named years the caterpillars of the gypsy moth ravaged the entire territory from Kiev to Kazan, a territory about equal to all of our Atlantic States. These periodical outbreaks will occur through all time, in spite of the parasites, under the most favorable conditons.

4. The general desire of the taxpayers in this Commonwealth is to prevent the spread of this moth into the uninfested parts of the State, and to reduce them in the infested territory to such an extent as to prevent material damage The real purpose of the work by the U. S. Government is to prevent the moth from going into other States, so that as long as the United States and Massachusetts keep up the work against the insect there, is little if any, danger of the reinfestation of your State.

Yours truly,

(Signed) C. H. FERNALD.

LETTER FROM MR. A. H. KIRKLAND, SUPERINTENDENT OF GYPSY MOTH WORK IN MASSACHUSETTS.

BOSTON, MASS., December 31, 1906.

Dear Professor Stene:

I take my first chance to reply to yours of the 26th, and am very glad if I can be of any help to you. Answering your questions *seriatim*, I would say:

(1) By all means I should advise your State to attempt to exterminate the gypsy moth from its borders. There are no serious infestations in southern Massachusetts from which you are liable to receive the moth, and with the work we are doing here, the danger of the insect spreading from Massachusetts into Rhode Island will grow less and less each year. Your problem is not a large one in area, and I should do all I could to absolutely exterminate the insect from the State. This can be done if you have sufficient funds and the work is properly handled.

(2) The outlook for securing natural parasites is as good as could be asked for. There is no question about getting plenty of the material. The only ques-

PLATE XXIV.

The breaking off of branches or bad pruning is responsible for hollow trees. In order to prevent these hollows from becoming the hiding places of the gypsy moth it is necessary to close them up. This illustration shows how the tree has been repaired with zinc patches.

tion is how well they will adapt themselves to this country, and how much help we shall get from them in the new environment.

(3) The amount necessary to exterminate the moth will probably be somewhat greater—say 25 per cent.—than the amount required to control it.

(4) It is only fair to say, after all, that we do not know absolutely that the parasite experiment will be a success. If it fails, and nothing is done in your State until the failure is demonstrated, you will indeed be in a bad way. If it succeeds, then you can probably drop or very materially reduce the size of appropriations required.

(5) With abundant funds you ought to exterminate the moth in Rhode Island in five years. With diminished appropriations, such as legislatures are apt to make, it may take from eight to ten years.

Truly yours,

(Signed) A. H. KIRKLAND,

Superintendent.

LETTER FROM D. M. ROGERS, SPECIAL FIELD AGENT FOR THE BUREAU OF ENTOMOLOGY IN CHARGE OF THE UNITED STATES GYPSY MOTH WORK IN NEW ENGLAND.

No. 6 BEACON STREET, BOSTON, MASS., January 4, 1907.

Dear Professor Stene:

Wish to acknowledge receipt of your letter of January 3, and will try to reply to your questions in a way to help you all I can.

As to the expenditure of government money in the different States, will say that Massachusetts has the most moths and is doing the most toward fighting them and naturally is getting the larger part of the Congressional appropriation. The work in Massachusetts has principally been confined to clearing up of roadsides through infested woodland. While the State moth laws are quite effective in clearing the moths from residential sections, the woodlands of low assessed valuation receive almost no attention, and in these spots the moth has been allowed to increase to enormous numbers, and in the caterpillar stage devour all the foliage and crawl about in search of more. Dropping from the trees being one of the great reasons for its spread, we believe that by clearing up these areas so as to keep the moth from scattering in this way, we shall in a great measure prevent their spread. We are cutting all the underbrush, trees which are dead or have unusually rough bark, pruning the dead wood from the remaining trees, leaving only good specimens upon which the moth can be fought with the greatest success. These strips are about one hundred feet wide on each side of several

main avenues of travel, particularly those frequented by through traffic from the infested centers, such as Newburyport Turnpike, Lowell Turnpike, and other roads which have badly infested woodlands along them, and are frequented by automobiles or market gardeners going long distances.

At the time the Government took hold of the work in Rhode Island, the caterpillars were nearly through feeding and the moths were already depositing egg-clusters. The men found and destroyed a great many caterpillars and pupæ, but the work has been confined principally to creosoting of the egg masses, cutting brush, and cleaning up. We have expended in Rhode Island, since the Government took hold of the work, not quite $4,000, and shall probably continue to spend about $700 per month until the caterpillars begin to hatch or we have covered the territory. The city of Providence has been all gone over, and cleaning gangs are now working in Cranston and will next take up Johnston. We also have five men in a separate gang scouting the northeastern part of the State. They have found no gypsy moths in Woonsocket, North Smithfield, or Cumberland, so far as it has been looked over. We hope to continue this scouting work until all the localities which seem to be most likely to have had the moth introduced have been examined, which I should think would include from one-third to one-half of the State. Should the moth be found outside the district now known to be infested, we would undertake to destroy such colonies as rapidly as possible.

In New Hampshire, the Government began gypsy moth work about the first of August, and most of the work that has been done is the examination of the territory locally known as "the coast towns." The gypsy moth has been discovered in all of these towns, though not in very large numbers in any single locality. All that has been found has been destroyed, except in a few instances. These are localities where it will be necessary to do climbing, chopping open of hollows, cutting down of trees, burning brush and cleaning. This will be attended to before time for the eggs to hatch. We now have in New Hampshire seven men, and it is our purpose to keep them there until about May 1.

Scouting operations were begun in Maine about the middle of November, during which time we have found the gypsy moth established in five towns. The only work done in the Pine Tree State is this examination of territory and the destruction of the egg clusters wherever they have been found. There are now eight men at work in Maine.

In Connecticut the State authorities have done all the gypsy moth work which has been done so far. All the known infestation is confined to an area of about a square mile in the town of Stonington. There has been a small crew of men at work, under the direction of Dr. W. E. Britton, a large part of the sime since the spring of 1906. That State alone is showing a disposition to handle its own moth

PLATE XXV.

This photograph illustrates the injuries which are so commonly found on the street trees of our large cities. They are caused by the gnawing of horses, or by driving carriages against the tree and rubbing off the bark. Such trees when a little more fully decayed form holes in which the gypsy moth finds convenient shelter. A creosoted gypsy moth egg cluster is shown above the injury.

problem, but later we hope to put a crew into the country surrounding Stonington for the purpose of scouting a wide margin around the infested territory.

In all of the New England States which are infested, we are doing what seems to be the most necessary work, without favoritism. Aside from Massachusetts, Rhode Island has received the most assistance, because it has more serious infestation than the other States.

Your question as to what assurance the people have that the moth will be kept out after they have accomplished extermination is a poser, and I do not believe I can answer it with any satisfaction to you or myself. In reply to your question as to future policy, will say that in all probability, if Congress continues to make appropriations, this department will do all that it can in aiding each of the States along present lines, unless there should be discovered more practical methods.

As to matter of policy for your State, would say that it seems to me desirable for your legislature to make sufficient appropriation to attempt extermination. With the very best work they could possibly do, and with liberal appropriations, it will be several years before actual extermination can be expected. Even if this should not be accomplished, I believe it best to strive for it. Suppression that would prevent any serious injury being done to the foilage or crops of the infested locallity could be accomplished without enormous expenditure, but such appropriations would be necessary for a great many years and the leaving of a few moths over this area would increase the chances for spread, so that in time a suppressive policy over a large area might prove to be in the end more expensive than the exterminative policy over the area now known to be infested.

While the sum of $25,000 may look to your people as a large amount to be expended in fighting the gypsy moth, will say that it is not a cent more than you will find use for. You know what the last summer's work cost, and that a great deal larger area will need similar treatment the coming season. The city of Providence should have almost every tree within its borders burlapped, and while we do not know what part of Cranston and Johnston will need attention and whether the moth will be discovered outside of this district, you will see the necessity of quite an increase in the burlapped area, and considerable territory which will need spraying and next fall an extensive and careful cleaning.

I cannot say very much to you in regard to the national appropriation. I suppose the bill was introduced with the Budget, but when it is coming up for any special hearing I am unable to say.

Very truly yours,

(Signed) D. M. ROGERS.

LETTER FROM DR. W. E. BRITTON, OF THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION, AND STATE ENTOMOLOGIST.

NEW HAVEN, CONN., December 31, 1906.

MR. A. E. STENE.

DEAR SIR:—On my return from attending the meeting at New York, I find your letter awaiting me. Approximately one square mile is all the territory that we know to be infested by the gypsy moth at Stonington, and we have not found it elsewhere in the State. This area is situated just north of the village, and as you will see from the accompanying sketch, it is interrupted on the east and west by water, so that unless carried, it can spread only to the north, and if has not gone beyond the point where we found it, I think we will be able not only to hold it in check, but to exterminate it completely. We have done much scouting around the northern part of this region, and have not found it beyond the area indicated by the red lines on the map. It is difficult to find any egg-masses, though we are having the ground gone over very thoroughly. I believe it will be possible to exterminate it.

The United States appropriation which is being expended by the Bureau of Entomology has not yet been extended to Connecticut, although arrangements have been made, and I expect that Mr. Rogers will send some scouts into our State within a few days. I doubt if the gypsy moth can ever be exterminated in Massachusetts.

We shall ask for a special appropriation from the legislature of probably not less than ten thousand dollars, for two years, possibly more. Our own experience so far points to the wisdom of having some money set aside or made available for just such work as this. Had Connecticut been in the same condition as Rhode Island, or in fact any of the other New England States except Massachusetts, this gypsy moth colony must necessarily have spread and covered a far greater territory before any efficient work could have been done, or before any funds could have been raised for carrying it on; but Connecticut had five years ago made provision for State work against insects, and the Board of Agriculture had a surplus on hand, which made our immediate work possible.

There is no special effort being made to secure further appropriations from the National Government; yet I shall, of course, endorse the work which they are doing, and shall favor the continuation of their appropriation, and probably ask for its increase. All New England States, or at least those infested, should stand together along this line.

With best wishes, I remain,

Very truly yours,

(Signed) W. E. BRITTON,

State Entomologist.

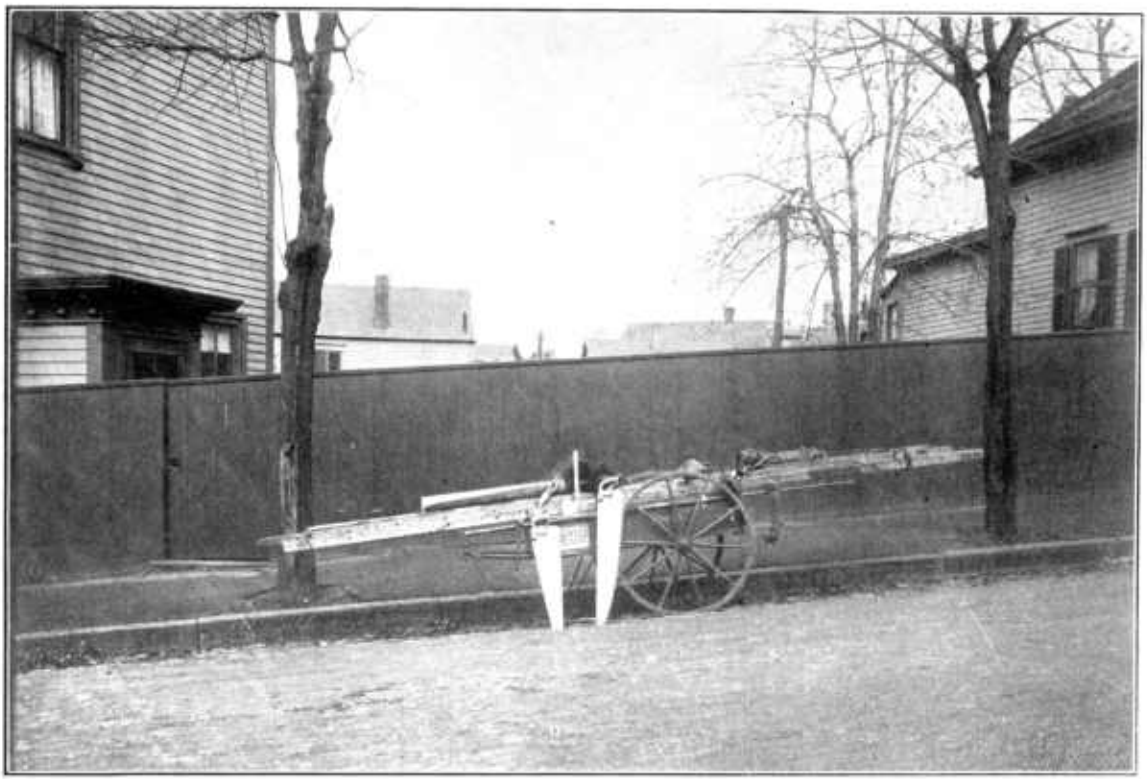

PLATE XXVI.

One of the carts used by the men in carrying their tools and supplies from place to place. The picture shows ladder, extension poles for brushes, saws, zinc, axes, climbing irons, etc., which are essential for the various kinds of cleaning work done.

LETTER FROM DR. E. PORTER FELT, STATE ENTOMOLOGIST OF NEW YORK.

ALBANY, N. Y., January 5, 1907.

PROF. A. E. STENE.

DEAR PROFESSOR STENE:—Replying to your communication of December 29, it is certainly most advisable to have liberal appropriations for controlling both the gypsy and brown-tail moths. Personally, from my knowledge of the gypsy moth and lack of very definite information concerning the Rhode Island infestation, I would not deem it advisable to advocate the adoption of exterminative measures for the eradication of the gypsy moth. It might be that an examination of the territory would lead to a revision of this opinion. The experience in Massachusetts has shown it to be almost impossible to secure the large sums necessary for successful exterminative work during a series of years, and unless there is no doubt as to obtaining sufficient money to accomplish the purpose, it is far wiser, in my judgment, to be content with repressive measures.

The gypsy moth spreads very slowly, and it is undoubtedly true that, were the insect to be exterminated in the city of Providence and its vicinity, there would be no recurrence of the pest for a number of years, provided the present repressive measures are rigidly enforced in Massachusetts. We all hope that the latter will be continued for a long term of years, and the further spread of the moth stopped until natural enemies of one kind or another are able to adequately cope with the pest. Unfortunately, if history repeats itself, and such is very likely to be the case, we have no guarantee that the present highly efficient measures will be continued for more than a relatively few years. The result would inevitably be a greater spread of the moth, and it is measurably certain that the automobile in the future will be even more effective than it has been in the past in carrying this pest, unless more strict measures are employed to prevent its dissemination. These considerations lead me to question very seriously the advisability of attempting to exterminate the insect from any extended infested area within fifty or one hundred miles of the large section now inhabited by this pest.

There is a serious danger of the gypsy moth being brought into New York State, and this has made it advisable to disseminate widely information concerning the insect for the purpose of enlisting the coöperation of the public in detecting this pest upon its earliest appearance. Last summer this office issued an illustrative placard giving the salient features of both the gypsy and brown-tail moth, and this was followed by a summarized bulletin treating of the two species. This has resulted in a great many of our citizens becoming deeply interested in insects, and many of the leaf-feeders were sent in for identification. Such general interest should make it nearly impossible for the gypsy moth or any similar pest to become well established over a large area before it was detected. We have

also inspected various places in the State where there seemed to be the most chance of the insect being introduced, and some work of this character has also been done by the agents of the State Department of Agriculture.

It is very probable that an emergency appropriation from the legislature will be requested this year, so as to have some funds on hand in case an infestation is discovered. The amount cannot be stated, but I would certainly favor the making of a liberal appropriation because of the obvious advantages in having plenty of means at hand in such an emergency.

All parties in New York State interested in this matter will gladly lend assistance toward securing appropriations from the national government, for the purpose of aiding the States now infected by these insects, since it is well recognized that repressive measures mean the protection of all to a considerable extent

Trusting that you will find the above of service, and assuring you of my interest in the matter, I am,

Yours very truly,

(Signed) E. P. FELT,

State Entomologist.

LETTER FROM PROF. E. D. SANDERSON, ENTOMOLOGIST OF THE NEW HAMPSHIRE AGRICULTURAL COLLEGE AND EXPERIMENT STATION.

DURHAM, N. H., January 7, 1907.

MR. A. E. STENE.

MY DEAR MR. STENE:—Yours of December 27 and January 3 at hand. I will send you in a few days a copy of a bulletin now in press giving the present conditions in New Hampshire. A bill will go into the legislature in a day or two of which I shall also be glad to send you copies as soon as I can secure them from the printer. I believe it will be possible to exterminate the gypsy moth in New Hampshire, I think it will take at least three or four years. I believe that by constant inspection we can keep our State clear of it from Massachusetts. I most certainly think that it would be cheaper to try to exterminate and keep out the pest than to depend on natural enemies and special legislative appropriations. If the gypsy moth ever gets a foothold in New Hampshire, there is a very slim chance of our being able to control it, as far as the present experience indicates. I believe that sometime in the future the parasitic and predaceous enemies will bring the gypsy moth to a condition similar to that in Europe. Whether this will be five, ten, or a hundred years, nobody knows. There is no question at the present time we must do everything possible to exterminate it.

We are now taking up the matter of additional appropriations from Congress with our representatives and senators, and we trust that the appropriation will

be increased to $250,000. The two bills to be introduced in the New Hampshire legislature provide essentially for the office of State Entomologist, and for an appropriation of around $40,000 for the moth work. The entire work and power to make regulations is placed in the hands of the State Entomologist.

Very truly yours,

(Signed) E. D. SANDERSON.

LETTER FROM E. F. HITCHINGS, STATE ENTOMOLOGIST OF MAINE.

AUGUSTA, ME., January 1, 1907.

PROF. A. E. STENE.

MY DEAR SIR:—Your letter received this morning, and will hasten to reply. As to the infestation of the gypsy moth in this State, I can only give a partial report, as the U. S. Commissioners are still at work here.

They found quite an infestation in the towns of Kittery, Elliot, and York, and are now at work in the town of Wells. They will continue to scout over the whole section from Kittery to Portland. A stray egg-cluster was found at the Soldiers' Home at Togus, near Augusta.

I hardly think it possible to *exterminate* the moth in Maine, unless the national government joins hands with us. I am confident that the pest can be *exterminated* in New England *if* we *all* pull together.

It will mean a *strong pull* and that *right now; next year won't do*, that is, there must be concerted action along the best possible lines of work and investigation, and that right away. Our legislature will meet to-morrow. We have had one committee meeting and will hold another soon. I cannot say just what will be done, but it will be something, and I hope something substantial.

As to the State work outside of Massachusetts, I think that each State should do its utmost to get rid of the pest within its borders, and have a contingent fund to draw from in case of any emergency.

I think that our only hope is to secure, if possible, as large an appropriation from our national government as may be, so that they can join with us in stamping out this insect pest.

As to natural enemies, I have no hopes whatever from any assistance from our native parasites; it may be possible that the foreign ones may become acclimated so as to hold them in check, so that only occasional devastations will occur; but they will *never* exterminate them, in my judgment.

Very truly yours,

(Signed) E. F. HITCHINGS.

THE BROWN-TAIL MOTH.

(*Euproctis chrysorrhœa*, L.)

As will be noted from the resolutions which were passed last spring by the General Assembly, the money appropriated was to be expended for the suppression of both the gypsy and the brown-tail moths. While these two insects have been companion pests and have thus fallen under the ban of law to an equal degree, they are very different in their life history and must be dealt with in a different way. The principal reason for this is that the gypsy moth spreads very slowly, and largely by human agencies, and therefore can be controlled or suppressed, and even exterminated in areas where sufficient work is done to that end. It is also somewhat limited in its present extent as compared to the more recently imported brown-tail moth. Both sexes of the brown-tail moth are strong flyers and spread rapidly of their own accord, and are now distributed over a large territory. Hope for extermination in this country is entirely gone. If exterminated in one section of the country, a favorable wind at the time of the flying of the moths will reinfest this territory, within one season, almost as thoroughly as if no work had been done.

The habits of the brown-tail are also different, and such that the fight against this insect is quite simple and may be left more generally to individual efforts. The egg clusters of the gypsy moth in which the insect passes the winter are hidden away in various nooks and corners as well as on trees, and it takes experienced men and close scrutiny to discover all the clusters which may be found in any given locality. The brown-tail moth, on the other hand, passes the winter in the caterpillar stage in closely woven nests which are nearly always found at the tips of the branches of the trees which it infests. These nests are, therefore, easily seen even by unskilled workmen, and can be readily cut off and burned to destroy the insect.

Fortunately also the brown-tail moth, although causing a great deal more personal discomfort when present in large numbers, is not so serious a pest as the gypsy moth. As has been learned already, the gypsy moth feeds on nearly all kinds of vegatation, including both deciduous and evergreen trees, and is especially destructive to the latter. The brown-tail is limited in its food-plants, being found usually on fruit trees and on but a few species of forest trees, and does no damage to field and garden crops. It is an insect also which, on account of its life history, is much more subject to the vicissitudes of climate and to destruction by fungous and parasitic insect enemies. In this connection it may be noted that, according to the reports from Massachusetts, a fungous disease, Empusa aulicæ (*Empusa grylli*), has been very destructive to the brown-tail caterpillars in many sections of the infested territory; so much so that in a great many places where the brown-tail has been a more disagreeable pest than the gypsy moth, there has been hardly a complaint this year from its presence.

The sum total, then, of the discussion of these two pests is about as follows: It is possible to exterminate the gypsy moth and money expended to that end is well spent, and it can be kept out if once exterminated. The brown-tail we have no way of controlling by any mechanical means, and appropriations for fighting it must be devoted largely to such measures as are necessary for suppression. The work of suppression can, to a certain extent, be done as well by individuals as by the State, and as the gypsy moth demands immediate attention, the brown-tail can and should wait for consideration until sometime in the future when it will be absolutely necessary to deal with it.

How much of our territory is infested can not be accurately known. During the summer and fall, however, the insect has been reported from Woonsocket, East Providence, and Pawtucket. It has also been rumored that a few specimens have been found in Providence, but so far the infestation is not so very serious except perhaps in Pawtucket. One of the principal efforts of the State should be that of publishing such reports and accounts of the insect as shall enable

the people of the State to become thoroughly acquainted with it, so that they can make efforts to keep it in check on their property, should it occur. In accordance with this idea, a short descriptive account of the insect will here be given.

History and Distribution of the Brown-Tail Moth.

This insect was imported into this country sometime after 1890, and was first noticed around Somerville, Massachusetts. It is not definitely known how it was brought over, but circumstances indicate that it was carried across the ocean on nursery stock. Like the gypsy moth, it attracted but little attention at first and was thought by the people of the district to be some native insect which had always been with them. In 1897, however, it had become such a destructive pest that it was brought to the attention of the gypsy moth workers and by them identified as the brown-tail moth so common in Europe. There was at that time no appropriation made for fighting anything but the gypsy moth, and consequently but little could be done except to ascertain the extent of the infested region. Precious time was therefore lost, and with it the hope of ever being able to exterminate the insect in this country. Later on a little money was appropriated for use against the pest, but it was merely sufficient to keep it partially in check in some of the thickly settled districts of the infested region. Since that time it has spread rapidly, until it has now been reported from the White Mountains in the north, eastward all along the coast of Maine into New Brunswick, south of Boston along Cape Cod Bay, into the eastern part of Rhode Island, and westward in Massachusetts to the Connecticut Valley. It is only a question of time when it will probably spread throughout the whole temperate region of North America.

It is a pest of no mean importance, owing especially to the irritative properties of some of the hairs, which will be mentioned later in the description of the insect. Infested districts have been made more or less uninhabitable to a great many people, and in some cases it has resulted in the reduction of real estate values and of property rentals

PLATE XXVIII.

Winter Nests of the Brown-tail Moth.
After Britton, Rep. of Entomol, 1892, Conn. Exp. Sta.

from twenty per cent. to fifty per cent., aside from the destruction which it causes to the trees on which it feeds. Where both the brown-tail and the gypsy moths have been prevalent, trees have had slight chances for existence. The gypsy moth caterpillar takes up the work where the over-wintering brown-tails have left off and finishes the defoliation of the trees. By the time the second crop of foliage has been sent out by the trees, in a vain attempt to rehabilitate themselves, another brood of the brown-tails has been hatched ready to take hold, and the "lungs" of the trees are destroyed a second time. Such thorough stripping will result in the death of even a deciduous tree in one or, at least, two years.

The range of the brown-tail moth in the Eastern Hemisphere is probably nearly as great as that of the gypsy moth. In Europe it is known as the common caterpillar, and serious outbreaks of it are frequently noted. Its parasitic enemies are, however, firmly established and the outbreaks are similar to those of our forest tent-caterpillar and Army worm and are of comparatively short duration.

Life History.

The eggs are laid, two or three hundred in a cluster, in July, usually on the under side of leaves at the extremities of the branches. The eggs hatch in three or four weeks and the caterpillars at once begin to feed on the upper surface of the leaves. When winter comes on, the caterpillars, usually from two to three hundred in number, retreat to these nests, close up the openings and hibernate during the winter.

In the spring they appear about the time that the buds open and immediately begin to feed on the buds, unfolding leaves, and flowers of the trees infested. They become full-grown about the middle of June and begin spinning cocoons, usually in the leaves of the trees. Sometimes two or more caterpillars may unite in forming such a cocoon. The moth appears in two or three weeks, and both sexes fly actively by night. The flight usually begins at from 7 to 8 o'clock in the evening and reaches its height at from 10 to 11 o'clock. It is attracted to light and is found in large numbers around electric light

poles, and frequently flies into the open windows of trains and electric cars to be carried long distances from its starting point. As food-plants, it prefers the pear, the apple, and other fruit trees, and the oak, maple, and birch; but these are by no means all the trees that it attacks.

Description of the Insect.

The egg clusters of the brown-tail moth are very much smaller and more elongated than those of the gypsy moth. The eggs are closely covered with golden-brown hairs from the tip of the abdomen of the female. The caterpillar is hairy, and after the first molt acquires characteristic yellowish or coral-red eversible tubercles, one on each of the tenth and eleventh segments, by which it can be readily distinguished. When full-grown the caterpillar is from one to one and one-third inches in length and of a dark-brown ground color with scattered yellowish markings. The body is covered with yellowish-brown hairs growing largely from the tubercles. Two rows of tufts with partially white hair give the caterpillar the appearance of having a broken white line along each side of the back. The coral-red eversible tubercles on the tenth and eleventh segments, already mentioned, are also present. The head is mottled black or dark-brown, and the legs are a reddish-yellow with black claws. Some of the very fine hairs which appear, especially toward the latter part of the caterpillar's life, are minutely barbed in such a way that when they fall on the skin they penetrate the tissues and cause a very annoying irritation, such that persons are sometimes made quite ill from the effects of it, and many have to vacate their homes in the infested regions during the height of the caterpillar season. The caterpillars become about one-fourth grown in the fall and finish their growth in the spring. When full-grown they attain a length of from three-fourths of an inch to one and one-fourth inches.

The pupæ are dark-brown in color and considerably smaller than the corresponding stage of the gypsy moth. The moths emerge in two or three weeks, or about the middle of July. Both sexes are

white except at the tip of the abdomen, which carries a pronounced tuft of golden-brown hairs. The male has a wing expanse of about one and one-fourth inches, and sometimes the wings are dotted with black spots. The female is pure white, except as noted above, and somewhat larger than the male both in wing expanse and size of body. The characteristic brown tuft of hairs is also larger and more pronounced than in the male.

The brown-tail moth has a great many parasitic enemies. Many of the native parasites which have been mentioned in connection with the gypsy moth also attack the brown-tail. On account of the crowding of the caterpillars in the nests for a large part of the year, fungous diseases have an abundant opportunity to become destructive. Birds also are known to take an important part in checking the numbers of the insect, and it is related that even the notoriously useless English sparrow has been efficient in reducing its numbers.

Remedies.

On account of the nests being placed in conspicuous positions the remedy, par excellence, is cutting these off and burning them. That such work results in the destruction of a great many caterpillars, as well as the fact that the insect often becomes very numerous, will be evident from the following note taken from the first annual report by Supt. Kirkland:

"As affording an idea of the abundance of the brown-tail moth, even in limited areas, where conditions favor the increase of the insect, the figures given by William Allen, Assistant Superintendent, Mount Auburn Cemetery, Cambridge, are of interest. During the winter of 1904–05, Mr. Allen removed from the trees in the cemetery 700 bushels of brown-tail moth webs, averaging 330 webs to the bushel, or a total of 231,000 webs. Estimating these at the average figure of 250 caterpillars per web, we have 57,750,000 caterpillars destroyed by the operation."

The only other practical remedy is that of spraying, and this is also very efficient for trees in cultivated grounds. The brown-tail

moth caterpillar is far less resistant to poison and can be killed by a spray of one-half or even one-third the strength of that which must be used for the gypsy moth.

Banding is also useful in the same way as for the gypsy moth, namely, to prevent the infestation of clean trees by caterpillars from neighboring neglected trees.